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MISCELLANEOUS PUBLICATION NO. 437

Washington, D. C. March 1942

TESTING FARM SEEDS IN HOME AND SCHOOL

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TESTING FARM SEEDS IN HOME AND SCHOOL[1]

By Albina F. Musil[2]

Assistant botanist, Division of Forage Crops and Diseases, Bureau of Plant Industry

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INTRODUCTION

Progressive farmers who recognize the importance of better and more profitable crop production know that trueness to name, adaptation, and quality of the seed used is worthy of careful attention.

The results of seed tests made at the United States Department of Agriculture and at the State seed-testing stations have shown that

[1] This publication supersedes Farmers' Bulletin 428, "Testing Farm Seeds in the Home and in the Rural School," by F. H. Hillman. The general plan of the original bulletin has been followed and, except for minor changes, the construction of the homemade balance, many of the text figures, and the drawings and descriptions of the seeds for figures 31 to 35 have been retained as prepared by Mr. Hillman.

[2] The writer acknowledges the assistance of Edgar Brown, formerly principal botanist in charge, Division of Seed Investigations; E. H. Toole, formerly physiologist, Division of Seed Investigations; and all other Department officials who informally contributed valuable information. Acknowledgment is also made to Regina Olson Hughes, Division of Forage Crops and Diseases, for additional seed drawings.

certain kinds of farm seeds in which there is an active trade and a strong competition are sometimes misbranded or even seriously adulterated, the effect being that the farmer buying such seed gains a disappointing experience instead of a satisfactory crop. Sometimes the seed of certain farm crops contains seed of especially noxious weeds, necessitating labor and expense in preventing permanent injury to the farm. Seed may have a low germinating power due to age or to unfavorable conditions during development, harvesting, or storage. Seed is sometimes undesirable because it was produced in regions possessing a less rigorous climate than that under which it will be sown, or it is otherwise unadapted because of susceptibility to disease or insect attacks.

The popular agitation within recent years in the interest of better seed has brought about a marked change in trade conditions, but much room for improvement still remains. Most States now have laws regulating the sale of agricultural seeds. The common feature in these laws requires agricultural seeds to be labeled to show the various elements of quality, such as purity, germination, chaff, and weed-seed content.

The Federal Seed Act [3] sets up limits of quality that seed subject to the act must meet before it is permitted entry into the United States. This act also requires labeling and prohibits misrepresentation of seeds in interstate commerce. Although both Federal and State laws regulating the sale of agricultural seeds give valuable protection to the farmer, it is also important that he be able to judge for himself the general quality of the seed offered him as well as that of seed produced for his own use on the farm.

The purpose of this bulletin is to encourage seed testing in the farm home and in the rural school by explaining the essential features of seed testing and by showing how useful and interesting information may be gained by simplified methods.

Seed testing is admirably adapted for practical exercise work in rural schools giving instruction in elementary agriculture. If tests of seeds of local interest are made in the homes of the pupils, the results can be of real practical service. A study of farm seeds and their impurities tends to interest pupils in crops and weeds and in their interrelation on the farm. It leads also to an understanding of the State and Federal seed laws and to the correct interpretation of the seed labels that the seed laws require.

THE NEED FOR SEED TESTING

A knowledge of the quality of the seed to be planted is of the highest importance to the farmer. It is the purpose of the seed test to disclose any undesirable conditions of crop seeds that might result in failure of crops, an excessive cost of the actually good seed, or the introduction and spread of troublesome and noxious weeds. The usual laboratory test of a seed sample consists of a purity test and a germination test. In the purity test the seed is examined to determine the actual proportion of the crop seed in the sample: the quantity and kinds of other crop seeds that may be present: the quantity and kinds of weed seeds; and the quantity and character of the inert matter

[3] Copies may be obtained from the U. S. Department of Agriculture, Washington, D. C.

present. The germination test shows the proportion of the pure crop seeds that may be expected to produce plants.

Various factors may affect the planting value of farm seeds. An unfavorable growing season may result in a high proportion of poorly developed seed having low vitality, or the viability may be reduced by age or conditions of storage. Seed as it comes from the thresher often carries an excessive amount of weed seeds and inert material, such as chaff, stems, and sand or soil. Farm seeds sometimes carry a natural admixture of other crop seeds, as, for example, sweetclover in alfalfa. For certain purposes even a small admixture of another crop seed may be undesirable. Occasionally seed is adulterated by the addition of a quantity of seed of similar appearance but of inferior quality.

Many of the conditions that make seed testing necessary have been the result of the demand on the part of the consumer for low-priced seed. Various means have been employed to meet this demand, the most common practice being the use of old seed or worthless screenings. Prior to the enactment of the Federal Seed Act in 1912, seeds which were practically unsalable in Europe because of low quality found a far too ready market here. Various forms of seed adulteration have been practiced, and seed ill-adapted to climatic conditions in the United States has often been sold.

The willful adulteration of farm seeds, which was common at the end of the nineteenth century and continued into the present century, is now largely a thing of the past. It is seldom now that instances are found where seeds of low market value have been deliberately mixed with higher priced seed of other kinds where the two are of similar appearance. During the period referred to, seed of black medic and of bur-clover were imported to use as adulterants of red clover and alfalfa; Canada bluegrass, then relatively low in price, was mixed with Kentucky bluegrass; ryegrass was adulterated with meadow fescue or the reverse, depending on relative price; sweetclover was mixed with alfalfa and red clover. At the present time the chief substitutions found are the selling of seed of one variety of a cultivated crop for seed of another variety of higher market value, or the sale of a crop seed that is unadapted for the locality where it is to be grown.

Old stocks of seed of the clovers and of alfalfa having low vitality are sometimes mixed with new seed. Such seed is sometimes oiled and rubbed to give it the appearance of freshness.

Application to Different Kinds of Seeds

RED CLOVER AND ALFALFA

Importations of seed of red clover and alfalfa have varied greatly from year to year. In certain years there have been practically no importations, and in other years approximately one-third of the seeding requirements have been imported. The major part of the importations in the heaviest importing years came from areas producing seed ill-adapted for use in the United States. This has no doubt had a definite and deleterious effect in diluting and weakening the domestic adapted strains of these two staple forage plants.

Regulations under the Federal Seed Act require that a certain proportion of the seed of each lot of red clover and alfalfa imported into

the United States shall be stained in a color to indicate its relative unadaptability for use in this country, as well as to prevent the sale of imported seed as domestic seed. Staining requirements are subject to change over a period of time. Information concerning these requirements may be obtained from the United States Department of Agriculture, Washington, D. C.

The provisions of the Federal Seed Act restricting the quality of imported seed has stopped the importation of low-quality seed. Such seed was imported in large quantities before the first Federal seed law was passed.

Not all domestic-grown seed is equally well adapted to all regions in this country. Generally speaking, seed produced in areas where mild winters prevail lacks the hardiness required in the more northern sections. In some cases plants grown from seed produced in one region may be susceptible to some disease that is prevalent in another region, although the place of origin of the seed may be free from that particular disease. As a protection to both producer and buyer some State laws require that a statement of origin accompany seed offered for sale. Where this is not the practice, an experienced seed analyst can often determine the origin of the seed by the kinds of weed seeds present. The rules and regulations under the Federal Seed Act require a statement of origin, if known, on seed of alfalfa, red clover, and field corn (other than hybrid corn) in interstate commerce. If the origin of such seed is unknown that fact must be stated.

GRASS SEEDS

Because of the chaffy nature of grass seeds and the similarity of appearance of many kinds, accidental misbranding or an admixture of old seed or chaff readily escapes detection by both the dealer and the consumer. Poorly cleaned samples may have a high chaff content or a high proportion of light-weight, undeveloped grains. Improper methods of harvesting and curing may result in low viability.

Some of the noxious grass seeds are not easily distinguished from certain crop seeds with which they sometimes occur, as, for example, Sudan grass from Johnson grass or quackgrass from bluestem (western wheatgrass). As previously stated, a natural admixture of another crop seed may be objectionable for certain purposes or in certain localities. To illustrate, a trace of timothy present in bluegrass may be desirable for meadow or pasture planting but highly objectionable for lawns.

Appreciation of Good Seed Necessary

By means of the seed test it is possible for Federal and State seed-control agencies to bring under control many of the undesirable conditions that may be present in farm seeds. But complete effectiveness of the control will not be attained until consumers generally come to appreciate and accept only good seed. Consumers will need to know good seed from poor and to understand that the actual cost of the pure, viable seed is usually less in high quality seed than in seed of low quality that may be purchased at lower cost.

VALUE OF THE HOME AND SCHOOL TEST

Many phases of seed testing require the special training of a seed analyst and expensive laboratory equipment. The home test cannot be expected to produce the accurate results achieved by the trained seed technician, but with care and practice the commoner kinds of crop seeds may be tested by the beginner with sufficient accuracy to furnish valuable and interesting information. It should be possible to determine if the sample is true to name or is a mixture of kinds, to judge the general quality of the sample by the appearance of the seed, and to estimate the purity by separating the weed seeds and other impurities from the crop seeds.

Testing seeds for viability is not always satisfactory under home or school conditions. For many kinds of seeds special equipment must be provided in order to maintain the temperature and moisture conditions necessary to obtain complete germination. Without the necessary equipment only the more common, quick-germinating kinds can be expected to give dependable results.

The methods here suggested for making seed tests have been designed to produce, so far as possible, practical information without the equipment and technical training required for the more accurate official test.[4] The degree of accuracy of the test will necessarily depend on the accuracy and proficiency attained by the individual worker.

When the work is done in school, samples of seed of local interest and obtainable at the homes of the pupils may be used. If suitable seed is not obtainable locally, samples can usually be obtained from dealers. Making a collection of seeds of crop plants and of the weed seeds found in them adds to the interest of the work. For convenient use, the seed samples may be filed in small glass vials or cellophane envelopes. Each sample should be carefully labeled with the name, the source of the seed or the place and date of collection, and any other information of interest pertaining to the particular sample. Such a collection becomes a valuable reference set.

APPARATUS USED IN MAKING TESTS

The apparatus essential for making the simplified tests described in this bulletin consists of a balance so that a weighed quantity of seed may be used, forceps to separate the pure seed from the foreign seed and other impurities, magnifiers to distinguish the character of the seeds, and a germinator to test the viability of the seed.

The Balance

It is important to use a weighed quantity of seed in the test, because only in this way can the relative quantity or percentage of pure seed as compared with the quantity of the impurities be determined. This requires a balance sufficiently sensitive to be moved by a small weight, such as that of a few clover seeds, because only a small sample of seed is used in the test. A large sample would require too much time and labor.

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[4] The term "official test" as used throughout this bulletin refers to the complete type of seed test as made by Federal and State laboratories in accordance with the rules and recommendations of the Association of Official Seed Analysts.

Many schools are supplied with some type of balance as part of their laboratory equipment. Although these balances may not be as accurate as the expensive analytical balances used in making official tests, they will be found fairly satisfactory for the school test. Where the price

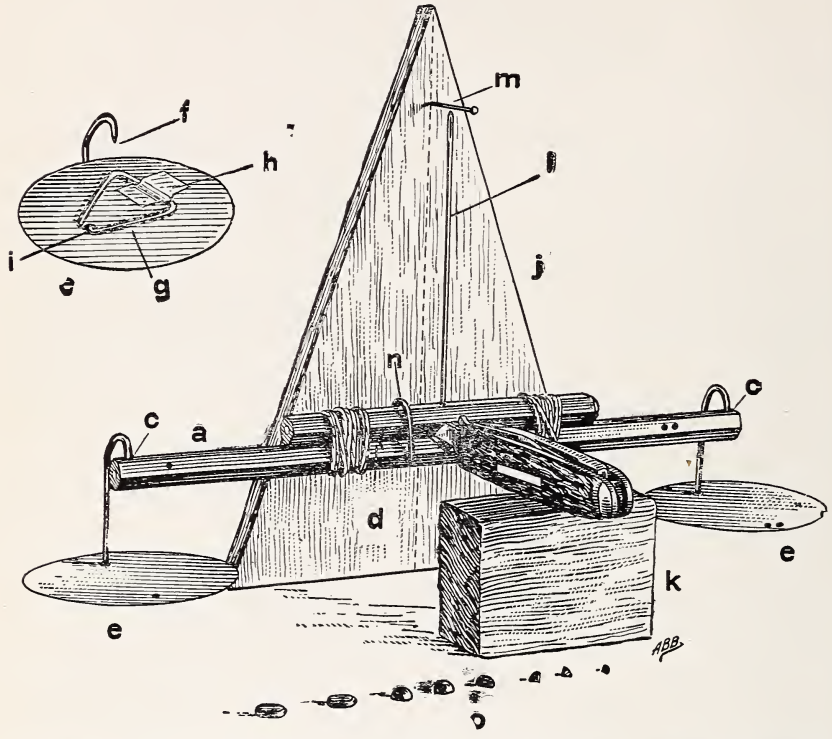

FIGURE 1.—A simple balance used in making the purity test of seeds: *a*, Six-sided pencil, full length, and a half-length pencil bound to the long pencil by rubber bands; *c*, shallow holes near the ends of the long pencil; *d*, reference mark common to both pencils at a convenient point on the line where they meet; *e*, trays for holding the seed and the weights, the upper one showing the under side; *f*, bluntly pointed end of the wire adapted to fit loosely in one of the holes (*c*); *g*, wire bent beneath the tray to hold it in position; *h*, piece of gummed paper holding the wire to the tray; *i*, hole at proper distance from the center of the tray where the wire pierces it; *j*, thin piece of board holding the parts of the balance in position; *k*, the block of wood holding the knife handle at proper level; *l*, darning needle serving as a pointer as the pencils oscillate in weighing; *m*, pin marking the position of the head of the needle when the trays are properly balanced before and at the close of weighing; *n*, "rider," or wire staple, so placed as to balance the trays when empty; *o*, series of selected BB shots used as weights; whole ones are flattened to prevent rolling; others are cut into halves, quarters, eighths, and sixteenths and selected with reference to the equality of their weights.

of even the cheaper balances on the market is prohibitive for home or school use a simple, efficient balance can be made by any boy or girl at all familiar with the use of a few common tools. The general construction is clearly shown in figure 1, to which the letters used in the following description refer.

The balance consists of a hexagonal, or six-sided, pencil (*a*) notched as nearly as possible in the center and halfway through the lead. Make a rather wide V-shaped notch. Half of a similar pencil is notched likewise at its center, care being taken that the angle at the apex or "bottom" of the notch is made narrow, straight, and smooth. At this point the balance rests on the small blade of a knife, as shown in the figure. The blade must not bind and the pencils must swing on its edge with the least possible friction. The two pencils are firmly rubber-banded together so that the two notches form an opening nearly square between the pencils. Near each end of the long pencil and on its notched side make a shallow hole (*c*) by boring into the wood with a hard pencil having a smooth, slightly blunt point. In order that the balance may operate properly the apex of the notch in the short pencil—that is, the point which rests on the knife edge—must be exactly midway between the holes in the ends of the long pencil. Slide the short pencil along the other till it is in proper position, then with the point of the knife blade cut a mark (*d*) common to both pencils on the line where they touch. The rubber bands should prevent the pencils from slipping when in use, but the mark will show if they do slip. Two similar trays (*e*) are hung from the ends of the long pencil. They consist of circular pieces of stiffish cardboard about 2 inches in diameter suspended by means of wires curved in fishhook form, the points of the hooks resting within the holes (*c*) previously made in the pencil ends. The points of the hooks (*f*) are bluntly and smoothly pointed, so as not to bind in the holes. Beneath the trays the wires (*g*) are bent to hold the trays in level position, and are held to the tray by pieces of gummed paper (*h*). The illustration shows the trays as flat pieces of cardboard. It is better to cut the trays from the edge to the center, then lap the two cut edges and glue them fast, thus making a shallow dish. The wire (*g*) beneath the tray is then preferably bent in circular form. Balancing the tray hook on the finger shows the proper bending of the wire where it pierces the cardboard (*i*) to make the tray hang level. A triangular piece of thin board (*j*), such as a cigar-box cover, serves to hold the knife blade in position. A block (*k*) holds the knife handle. The knife is set high enough to permit the trays to hang about one-half inch above the surface on which the balance rests. For the purpose of showing slight movements of the balance in exact weighing, a darning needle (*l*) is set in the top of the short pencil directly over the knife edge and at right angles to the pencil. A pin (*m*) is placed in the board directly over the point where the knife point pierces it and just above the end of the needle. When the device is properly balanced the end of the needle will stand at rest directly under the pin. It probably will not balance until a staple of wire (*n*) is placed over the pencils in proper position on one side of the knife blade or on the other as a counterweight. This completes the construction, and when properly mounted the balance should oscillate freely by the slightest touch. As the trays are likely to be interchanged in use it is advisable to mark each, placing corresponding marks on the ends of the pencil at which the trays preferably belong.

In making seed tests common BB shots (whole and fractional) may be used for weights, as only the comparative weights of the pure seed and of the foreign seed and other impurities in the sample are

needed. Thus if an amount of seed is tested that will balance 10 shots, and it is found that the weed seeds in the sample just balance 1 shot, it is evident that one-tenth of the original seed, or 10 percent, consists of impurities. In other words, 90 percent (or 90 pounds of each 100 pounds) of the original seed is pure seed. In using a balance so sensitive as the one described a single BB shot is too heavy for use as the lightest weight. A weight is needed that may be balanced by only a few clover seeds at most. Very small shot is troublesome to handle and count, so the larger BB shots should be used, the whole ones should be flattened to prevent them from rolling, and the others should be cut into halves, quarters, eighths, and sixteenths. The split BB shots (obtainable from dealers carrying fishing tackle) are convenient for this purpose. By careful selection according to weight a fairly uniform series (fig. 1, *o*) of whole and fractional shots can be provided. The weight of one-sixteenth shot is 1 percent of the weight of 6¼ shots, because 6¼ equals 100÷16. Therefore, if a sample of seed will balance 6¼ shots, any impurity that will balance the 1/16-shot weight represents 1 percent of the sample tested. If the sample is twice as heavy, balancing 12½ shots, the 1/16-shot weight represents one-half of 1 percent of the whole.

It is evident, therefore, that with the means described the quantity of pure seed or of impurities in a sample to within 1 percent, or even one-half of 1 percent, of the true quantity may be determined. This is sufficiently close for such tests as are discussed in this bulletin.

The Forceps

A pair of forceps is very useful in picking up the small weights used with the balance, also individual seeds. These may be obtained at small cost from any school supply store. A piece of spring wire bent in U shape and flattened at the ends serves very well as forceps.

The Magnifiers

Figure 2.—Magnifying glass.

The next step, after the seed to be tested has been properly weighed, is to separate the pure seed from the foreign seed or other impurities. This requires a magnifier. Very coarse seed—such as wheat, oats, and flax—can usually be examined by the aid of an ordinary reading glass, which is to be found in many homes or can be bought at a cost of $1 to $2. Clover seed, alfalfa seed, and the grass seeds require a magnifier of higher power. A lens that magnifies from 5 to 7 diameters may be used for this purpose. The tripod magnifier, shown in figure 2, or any of the folding or pocket types will be found satisfactory. These may be obtained at prices ranging from 50 cents to several dollars, depending on the kind and quality.

The Paper Tray

Seed is examined best over white paper, and in order to prevent the loss of seed from a weighed sample a paper tray made from stiff white paper, such as a sheet of heavy letter paper, may be used. The edges of the sheet should be folded over on all four sides, making a rim one-fourth inch wide. Folding the edges over the straight angular edge of some convenient object prevents the paper from warping and makes it easier to use. Cutting off one corner permits the seed to be poured easily from the tray.

The Germinator

Figure 3 shows a simple plate germinator.

Either clean blotting paper, absorbent cotton, absorbent paper toweling, or cloth may be used to hold the seed. Clean sand may be preferable for some kinds of seed. A germinator of this description is most useful in testing forage-crop seeds or seeds of cereals. In testing corn or other large seeds, the rag-doll seed tester [5] is very satisfactory, or the cloth method may be employed. This method makes use of a box of convenient size, say 20 inches square, interior dimensions, and 2 or 3 inches deep. The seed is placed on white cloth, preferably Canton flannel, which is cross-marked on the smooth side with distinct pencil lines in 2-inch squares. The required moisture is held by extra thicknesses of cloth or by clean sand beneath the cloth, forming a layer about an inch thick over the bottom of the box. If Canton flannel (which comes 27 inches wide) is to be used instead of sand, the box may be made narrower than suggested, say 12 inches, thus allowing for folding the cloth and for shrinkage.

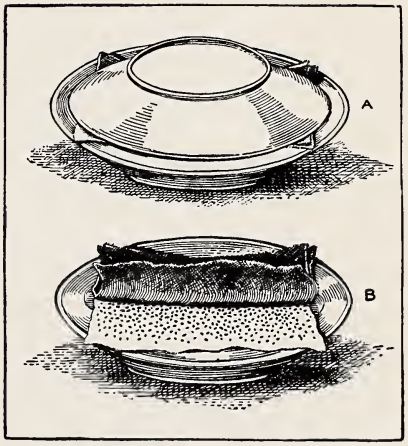

Figure 3.—Home-made seed germinator: *A*, Closed; *B*, open.

DETAILS OF MAKING SEED TESTS

Procedure

The natural course to be followed in testing farm seeds involves, in general: (1) The preparation of the small sample for the test; (2) the separation of the crop seed from its impurities; (3) a test of the germination of the crop seed; and (4) the determination of the actual value of the seed sample as compared with the pure seed. The tests should be made early enough in the season to allow ample time to

[5] Burt, George J., Biggar, H. Howard, and Trout, Clement E. The rag-doll seed tester, its use in determining what ears of corn are fit for seed. U. S. Dept. Agr. Farmers' Bul. 948, 7 pp., illus. 1918.

obtain other samples or to buy additional seed if the tests indicate seed of inferior quality.

Preparing the Test Sample

The size of the sample to be used for the test varies with the size of the seed under consideration. For official tests a quantity is used that will give approximately 3,000 seeds for the test.[6] It is obvious that a larger sample must be used of a large seed like vetch than of a small seed like bluegrass, in order to have a comparable number of seeds in each case. As the unit weight of seed recommended for the more exact official tests is in many cases too large to be practical for home or school purposes, the following suggested quantities may serve as a guide for the size of the test sample.

Kind of seed:	*Size of sample*
Bluegrass, redtop, timothy	1 gram. 2 BB shots. ½ teaspoon.
Alsike clover, white clover, orchard grass	2 grams. 4 BB shots. ½ to 1½ teaspoons.
Smooth bromegrass, alfalfa, red clover, sweetclover, crimson clover, lespedeza, winter rape, flax, meadow fescue, millet	5 grams. 10 BB shots. 1 to 2 teaspoons.
Barley, oats, Sudan grass, vetch, wheat	10 grams. 20 BB shots. 5 to 6 teaspoons.

It is important that the working sample should represent fairly the bulk of the seed from which it is taken. When seed in bulk, as in a sack, is to be sampled, small amounts of seed should be taken from the top, bottom, sides, and center of the sack. If the sack is emptied and the seed thoroughly mixed, a more representative sample can be taken.

As the small sample thus taken will be too large to be tested in its entirety, it must be further reduced by subdividing to obtain the test sample. In official tests this all-important subdivision is effected by the use of a mechanical sampler that takes a little from all parts of the larger quantity. In home testing perhaps there is no better plan than to pour the seed in a symmetrical pile on a flat surface and carefully subdivide it by means of a table knife until the approximate quantity needed for the test is obtained. For convenient use, small glass vials may be marked to show the approximate quantity needed for each of the different kinds of seed.

After the balance described on page 5 has been put in proper condition for use the total weight of the selected sample is taken and recorded in terms of whole and fractional shots, or of grams if a commercial type of balance is used.

Making the Separation

After the sample is weighed it is spread on a sheet of white paper folded in the form of a tray (p. 9), or, if the seed rolls readily,

[6] U. S. Department of Agriculture. RULES AND REGULATIONS UNDER THE FEDERAL SEED ACT. Service and Regulatory Announcements No. 156. 1940.

it is easier to handle if spread on a sheet of blotting paper or white paper toweling. With the magnifying glass held as close to the eye as possible, the sample should first be examined with reference to whether it is true to name. The seed of most farm crops can be recognized with certainty under careful examination as to its particular kind. Seed of different varieties of a kind as a rule cannot be distinguished in this way. For example, red clover seed can be distinguished from other seeds, but the medium and mammoth varieties of red clover cannot be distinguished by their seeds. Seeds of varieties of individual kinds of plants usually must be grown to insure varietal determination. This is not a part of the usual seed test.

The sample should next be separated into its component parts—pure seed, other crop seed, weed seed, and inert matter, such as pieces of stems, chaff, and badly broken seeds.

Both plump and shriveled crop seeds should be classed as pure seed. Although the shriveled seed may be worthless, it nevertheless is a part of the crop seed, and its worthlessness will appear in the subsequent germination test. In the case of broken seeds, any piece larger than one-half is usually considered pure seed, and pieces that are one-half or less are considered inert matter. In testing grasses, only those seeds that contain grains should be counted as pure seed, the empty glumes being considered inert matter. This is determined by pressing the seed lightly with the forceps. It is not practicable to do this with the very chaffy samples, such as bluegrass, without proper laboratory equipment. A simplified procedure is described under methods of testing Kentucky bluegrass (p. 27).

The impurities carried by farm seeds have an important bearing on the real quality of the seed. Their quantity may be sufficient to unduly increase the cost of the good seed, or their character may be that of injurious weeds. In official tests the foreign materials (other crop seeds, weed seeds, and inert matter) are separated and the quantity of each kind is determined individually. For the home or school test, unless certain kinds of crop seeds or weed seeds are especially abundant, the foreign matter for convenience may remain mixed together. If other crop seeds of similar appearance but of lower market value occur in quantity in the sample they should be left with the pure seed, and their proportion in the sample may be determined by the simplified method described under Determination of Other Crop Seeds.

After the separation has been made the pure seed is weighed. The proportion of pure seed is then determined by comparing its weight with that of the entire sample, expressing the results in percentage.

Determination of Other Crop Seeds

Attention should be directed to the possible presence of other crop seeds, which, because of their similarity of appearance to the pure seed, may be present as adulterants. Such other crop seeds are left with the pure crop seeds when the other foreign seeds are separated, as the time and labor required to separate the adulterant seeds from the pure seed of the entire test sample would not be justified by the

information gained. However, as the weight of these seeds is approximately the same as that of the seeds with which they are mixed, their relative proportion to pure seed may be determined by count from a small portion of the mixture. After all other foreign seeds and inert materials have been removed from the test sample and the pure seed weighed, 100 seeds may be counted out indiscriminately from the mixture of pure seed and adulterant. The 100 seeds should then be carefully separated into pure crop seed and adulterant seed, and the number of each ascertained by actual count. For example, if a sample of red clover is found to contain black medic to the extent of 40 seeds in 100 seeds of the mixture, the black medic is determined to be 40 percent of the mixture. If other foreign matter in the sample amounts to 15 percent, the clover and black medic together represent 85 percent of the original sample. The black medic adulterant, therefore, amounts to 40 percent of 85 percent, or 34 percent of the seed sample under test.

Examination of Weed Seeds

The weed seeds should be considered with respect to their total quantity and their character as affecting the crop and the land. Low-grade seed sometimes contains so much weed seed that the quantity of the crop seed is thereby reduced, and the actual cost of the crop seed is consequently increased.

Some weeds, once they are established, are extremely difficult to eradicate. Such plants are termed noxious weeds. Their presence results not only in loss of crops, but a great deal of labor and expense is involved in bringing them under control and in preventing permanent injury to the land. Bindweed and Canada thistle are familiar examples of this class of weeds. Many weeds vary in the degree of noxiousness with the conditions of locality, climate, and cultural practice under which they are grown. Other weeds are of little importance as field weeds, except as they occur in quantity.

Seeds of strictly noxious plants should be distinguished as well as those indicating the domestic or foreign source of the seed. Rural school pupils, especially, who make tests of seeds should be interested in identifying, so far as possible, the kinds of all the weed seeds found in seed samples. The weed seeds should be carefully compared with the illustrations and descriptions relating to them (see The Identification of Weed Seeds, pp. 34 to 63). Many kinds of weed seeds not illustrated in this bulletin will be found. Most of these as a rule are of relatively minor importance. The weed seeds that are most liable to occur in the different kinds of crop seeds will be found in the Appendix, table 1.

The Germination Test

The seeds of many grasses and other plants cannot be germinated successfully under home conditions, because they germinate very slowly and require special treatment under artificial conditions. The commoner, quick-germinating crop seeds, however, usually germinate readily under the conditions here described and may safely be tested in the home or school. Even with these seeds a low germination,

with the remaining seeds not decayed, may indicate that suitable conditions have not been provided and not that the seed is worthless. It is important in separating pure seed for the germination test that the counting be done indiscriminately, without selection as to the appearance of the seed. The tendency of the beginner is to select the more promising-looking seeds for the germination test. It must not be forgotten that the purpose of the test is to learn what percentage of the total pure seed will germinate. If the more promising seed is selected, the results of the test may give the sample a higher plant-producing value than it actually possesses.

The number of seeds to be used for the germination test varies to some extent with the kind of seed. For convenience in estimating the percentage of germination the usual practice is to use 100-seed counts, in duplicate or more. The average of the separate tests is then used in determining the percentage of germination. If only a few seeds were to be used for the test the results might not fairly represent the sample. By using a larger number of seeds the accuracy of the test is increased. It is obvious that accurate counting is important to insure accuracy in computing the results.

The time required for germination differs with the different kinds of seed. The usual time required for the completion of a test of average quality seed is, approximately—

Kind of seed:	*Days*
Clovers, rape, and most cereals	5 to 7
Vetch	10 to 14
Most grasses	14 to 21

As previously stated, if at the end of the usual time required for the test there is little or no germination and the seed remains firm, the right conditions may not have been provided. Such a sample should be sent to a State or Federal laboratory for test.

Having prepared the simple germinator described on page 9, the seeds should be evenly spaced on the moistened blotting paper or other substratum, to prevent crowding of the germinating seeds. The conditions essential to seed germination are sufficient moisture, warmth, and air. A light covering of cloth, paper, wood, or glass for the seed germinator, so as to prevent too rapid loss of moisture by evaporation but not hinder the admission of air, should be provided. In order to insure sufficient air, very small seeds germinate best on top of the germinator cloth or paper, whereas larger seeds do better when placed between cloth or paper folds. Sufficient water should be supplied to keep the seeds thoroughly moistened during germination, but they should not be allowed to rest in water. The temperature of living rooms ranging from 65° to 85° F. is suitable for germination. A place in the room should be selected where the day and the night temperatures will be fairly uniform. Thus the window sill is too cold in winter, and a shelf directly over the stove is too warm. The germination of some kinds of seeds is favored by the varying day and night temperatures of living rooms. Germination tests made in cloth, paper, sand, and soil may be compared, showing the effect of surrounding conditions.

When sand or soil is used in testing germination, the seeds should have a light covering. Before the sprouts appear the surface of the sand or soil may be kept covered to hold the moisture. Germination

in sand and in soil is likely to be somewhat slower than when the test is made in cloth or paper.

Seed in the germinator should be examined daily to note the extent and vigor of germination. Weak, slow germination indicates low vitality, unpromising for good field results in plant production.

The sprouts should be removed at intervals during the period of germination and the number recorded. This gives more room for the succeeding sprouts and makes it possible to examine the individual seedlings before the roots become entangled. However, the sprouts should not be removed and counted before they are large enough to determine if they are healthy and appear capable of developing into useful plants. Clovers and other legumes in particular should be examined carefully for broken and abnormal sprouts that start growth but are incapable of continuing to grow into plants.

Some of the seeds of red clover, alfalfa, sweetclover, and other legumes do not absorb water readily. These are called hard seed. In an official test, the number of hard seeds present is stated in the germination report. Such seeds will usually grow if the seed coat is scratched or scarified to permit the absorption of moisture, care being exercised to prevent chipping or cracking the seed and thus injuring the seed embryo. The ability of hard seeds to produce plants in the field varies with the kind of seed and the time of year when they are planted.

Determining the Actual Value of the Seed

The actual value of the pure seed in a sample depends on its quantity, as compared with the total weight of the sample. The actual proportion of pure, viable seed in a sample is represented by the product of its percentages of purity and viability expressed in percent. For illustration, a sample is found to contain 80 percent of pure seed, and the germination test shows 70 percent of viable seed. The pure, viable seed of the sample under consideration would then be but 70 percent of the 80 percent, or 56 percent. Assuming that the seed sells at $10 per 100 pounds, the good seed actually costs nearly 18 cents per pound.

The ideal state of perfection in purity and viability of seed is rarely, if ever, attained. It is not practicable to establish a standard of quality that any one kind of seed can be expected to show. This condition may vary from year to year, and it is also dependent to some extent on the region of production. The best seed that is marketed should serve as a guide in this respect.

Sometimes seed, such as clover, is sold locally in the hull or chaff. If such seed is known to be free from noxious weed seeds, it can safely be purchased if proper allowance is made for the proportion of worthless chaff and undeveloped seed. An average sample of the chaffy seed may be weighed and its percentage of good seed ascertained. As clover seed weighs 60 pounds per bushel, the actual value of such chaffy seed can readily be determined, and the quantity to be planted accurately gaged.

GENERAL CONSIDERATIONS IN TESTING PARTICULAR KINDS OF SEEDS

As one of the first steps in testing farm seeds is to determine if the sample is true to name, it is necessary that one be able to recognize the different kinds with certainty. Most farmers can recognize seed in the bulk, as red clover for example, but it is not so certain that they would recognize the individual seeds under all conditions. The chances for deception are even greater with grass seeds than with clover seeds, because of the striking similarity between the seeds of different kinds when seen in bulk.

Familiarity with the distinguishing characters of the individual seeds of each kind is essential in seed testing. A careful examination must be made with a magnifying glass to determine if a seed sample consists of the kind stated on the label or of another kind of similar appearance. It is equally important to be able to detect and separate an admixture of other crop seeds in a sample, as, for example, sweetclover in alfalfa or meadow fescue in ryegrass.

By careful study of the seeds of the several kinds with a magnifier and by comparing them with the illustrations and descriptions here given it should be possible to distinguish them individually as well as in bulk without much difficulty. It will be observed that there are distinctions of form, color, size, and the position and character of the seed scar (point of attachment), also the nature of the seed coat, which may, for instance, be smooth or rough, dull or polished. Note should be made of those characters that distinguish the kind under consideration from others of similar appearance. Artificial mixtures of seeds prepared in various combinations, such as alfalfa and sweetclover or red clover and black medic, furnish valuable practice in identifying individual seeds.

Most of the crop plants belong to one of three large groups or families of plants—Leguminosae, the bean or pea family, commonly known as legumes; Cruciferae, or mustard family; and Gramineae, the grass family. On the succeeding pages the discussion on testing particular kinds of seeds will be confined to those kinds in each group that are in most general use, and only such seed distinctions will be emphasized as are evident at the low magnification provided by the ordinary hand lens, such as described on page 8.

To avoid repetition, the previously discussed details of making seed tests (pp. 9 to 14) should be borne in mind, leaving the present discussion to conditions peculiar to the several kinds of seeds considered.

TESTING SEEDS OF THE LEGUMES

General Seed Characters

The seeds of plants of the legume family (Leguminosae) have a characteristic scar, or point of attachment to the pod, which distinguishes them from those of other plant families. Various modifications of the scar help to distinguish the kinds or species from each other, but with the exception of vetch these distinctions are often

too fine to be visible at a low magnification. Form, size, color, and texture must all be taken into consideration in making an identification. It will be observed that each species has a characteristic shape, roughly triangular, oval or oblong, heart-shaped, kidney-shaped, or spherical. The position of the scar in relation to the long axis of the seed should be noted.

FIGURE 4.—Seeds of alfalfa: *a*, Individual seeds, showing variation in form; *b*, edge view of a seed, showing the scar; *c*, natural size of seeds.

Seeds of the true clovers (red, alsike, white, and crimson), alfalfa, lespedeza, black medic, bur-clover, and sweetclover are more or less flattened and notched in the edge. Within this notch the seed scar appears as a small, distinct ring (see figs. 4, 12, and 13). In clover, lespedeza, sweetclover, and black medic a single seed is usually produced in each pod. Consequently the seeds of each kind are very similar in form. Alfalfa and bur-clover produce several seeds in a spiral pod, resulting in considerable variation in the form and size of individual seeds. In the more or less spherical seeds of vetch the scar may be an oval, wedge-shaped, or linear area on the curved surface (see fig. 19). The type of scar is an important character in distinguishing the different species of vetch.

FIGURE 5.—Mixture of seeds of *a*, alfalfa, and *b*, sweetclover. The elliptical form of the sweetclover seeds with the scar notch near one end serves to distinguish them from the more nearly kidney-shaped and smoother alfalfa seeds. (Enlarged.)

ALFALFA

Alfalfa (*Medicago sativa*) seed is distinguishable by the somewhat variable kidney-shaped form of individual seeds (fig. 4) and by the greenish-yellow or light-brown color. It will be observed that, in general, the seeds are somewhat bent or warped so that they do not lie flat on a plane surface as do those of sweetclover (fig. 5). Old, poorly developed, and shriveled seeds have a dull, reddish-brown color. The relative sizes of seeds of alfalfa and of one form of dodded (*Cuscuta epithymum*) are shown in figure 6.

Alfalfa seed may contain incidental seeds of black medic (figs. 7 and 8); sweetclover (fig. 5); and burclover (fig. 9).

During years of low domestic production much imported alfalfa seed may be on the market. The question of domestic or foreign production may usually be determined by the weed seeds present, and, in addition, foreign production is indicated by the presence of stained seeds (see p. 3).

The hard-seed content of alfalfa seed is very variable depending on the conditions of production and threshing. Hard seeds of alfalfa have a tendency to soften more readily in the soil than do those of red clover and, consequently, may be of much value in producing a stand.

FIGURE 6.—Seeds of *a*, alfalfa, and *b*, clover dodder, showing relative sizes. (Enlarged.)

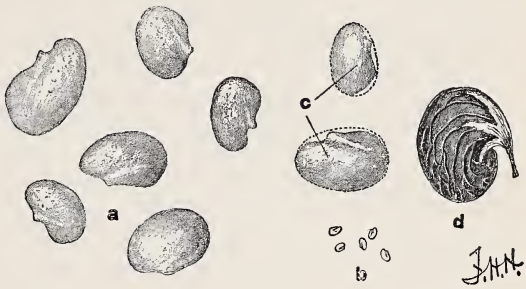

FIGURE 7.—Seeds of black medic: *a*, Seeds showing variation in form and size; *b*, natural size of seeds; *c*, oval form of seeds indicated; *d*, the seed pod.

ALSIKE CLOVER

Alsike clover (*Trifolium hybridum*) seed is distinguished from other kinds by its dark-green color, the small size, and the heart-shaped oval form of individual seeds. The lighter colored seeds are often mottled (fig. 10). Old seed is distinguished from new by the dull, reddish-brown color it acquires.

White clover seed often appearing in alsike seed is distinguished by its yellowish or pinkish color (see fig. 11, *b*).

Black medic seed, often present as an incidental

FIGURE 8.—Mixture of seeds of *a*, alfalfa, and *b*, black medic. Alfalfa seeds are more or less kidney-shaped or angular, whereas those of black medic are more uniformly oval and have the small projection at the scar more commonly evident. (Enlarged.)

impurity, is distinguishable by its greenish-yellow or brown color and the characteristic form of individual seeds (compare figs. 7 and 10). Alsike may be adulterated with old alsike seed, timothy seed, and weedy screenings (fig. 11). Hard seed is more frequently observed in alsike seed than in red clover.

FIGURE 9.—Mixture of seeds of *a*, alfalfa, *b*, California bur-clover, and *c*, spotted bur-clover. Note the larger size of the bur-clover seeds, also the kidney shape of the spotted bur-clover seeds, which have the scar near the smaller end. (Enlarged.)

Domestic production of alsike clover seed centers in the Northwest and in the North Central States. Canada is the principal source of imported seed.

WHITE CLOVER

White clover (*Trifolium repens*) seed resembles that of alsike clover in size and form of individual seeds (see fig. 11, *b*), but the average size is slightly smaller. The light-yellow, pinkish, or light-brown color of white clover seed distinguishes it from the darker alsike. Much seed imported from Europe is on the American market. Domestic seed is produced chiefly in Louisiana and Wisconsin.

White clover often contains more hard seed than either red or alsike clover.

CRIMSON CLOVER

The seed of crimson clover (*Trifolium incarnatum*) is larger than that of the other clovers, the individual seeds being elliptical and so slightly flattened that they roll readily on a flat surface (fig. 12). Fresh seed is pinkish and has a bright luster. As the seed ages it becomes dull and reddish brown. The viability deteriorates rapidly.

Adulteration is confined chiefly to the use of old seed, which may usually be distinguished by its color.

FIGURE 10.—Seeds of alsike clover: *a*, Seeds showing variation in form and surface appearance; *b*, natural size of seeds.

Much of the crimson clover seed on the American market is imported from Europe. A white-seeded variety is occasionally imported. American seed is produced chiefly in Tennessee.

FIGURE 11.—Alsike clover, with the incidental seeds commonly found in low-grade seed: *a*, Alsike clover; *b*, white clover; *c*, red clover; *d*, black medic (yellow trefoil); *e*, Canada thistle; *f*, curly dock; *g*, sheep sorrel; *h*, buckhorn plantain; *i*, blackseed (or rattail) plantain; *j*, rippleseed plantain; *k*, lambsquarters; *l*, shepherds-purse; *m*, mayweed (dogfennel); *n*, false-camomile; *o*, evening (or white) campion; *p*, nightblooming catchfly; *q*, oxeye daisy; *r*, littleseed falseflax; *s*, strawberryweed (cinquefoil); *t*, two kinds of peppercress; *u*, catnip; *v*, timothy; *x*, chickweed; *y*, Canada bluegrass; *z*, clover dodder; *1*, big mouse-ear (mouse-ear chickweed); *2*, knotweed; *3*, tumble amaranth; *4*, redroot amaranth; *5*, selfheal; *6*, ladysthumb. (Enlarged.)

RED CLOVER

Red clover (*Trifolium pratense*) seed may be distinguished by its yellow and violet colors and the triangular form of the individual seeds (see fig. 13). Old seeds are dull and reddish brown. Imperfectly developed seeds are dull brown and more or less shriveled. Note should be made of the apparent relative quantity of poor true clover seed in the sample and its relation to the results obtained in the subsequent germ nation test.

FIGURE 12.—Seeds of crimson clover (enlarged and natural size).

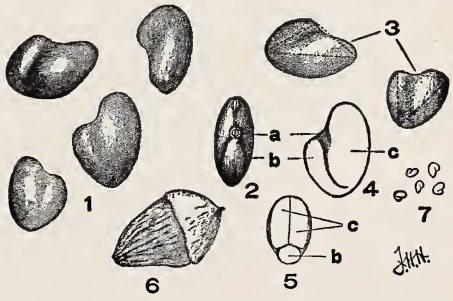

FIGURE 13.—Seeds of red clover: 1, Side view and, 2, edge view of seeds; 3, the triangular form indicated; 4, a seed cut lengthwise; 5, a seed cut crosswise, showing the embryo: *a*, Seed scar, *b*, root (radicle) of the embryo, *c*, seed leaves (cotyledons) of the embryo; 6, a pod of red clover; 7, natural size of seeds.

The foreign seed in red clover may include other crop seeds, such as alsike clover, white clover, alfalfa, or timothy. Note should be made of the presence, character, and quantity of such crop seed.

Figures 14, 15, and 16 show the relative sizes of red clover seed and the seed of three of its common impurities, black medic, clover dodder, and field dodder.

Intentional adulteration is comparatively infrequent at the present time. In previous years it was not uncommon to find an admixture of black medic (fig. 7) or old red clover seed disguised by oiling and polishing. In times of crop failure or insufficient supply of domestic seed the admixture of old seed or of miscellaneous screenings of shriveled seeds and weed seeds is still practiced in some cases.

FIGURE 14.—Mixture of seeds of *a*, red clover, and *b*, black medic. The clover seeds are more or less triangular, and those of black medic are oval and usually with a distinct projection beside the scar notch. (Enlarged.)

At the completion of the germination test, which usually takes 5 or 6 days, the seeds that have not sprouted should be examined to determine whether they are hard or soft. It is not uncommon to find 1 to 10 percent of hard seed in most commercial samples. Although such hard seed is probably all alive, it is of questionable seeding value.[7]

FIGURE 15.—Seeds of *a*, red clover, and *b*, clover dodder, showing relative sizes. (Enlarged.)

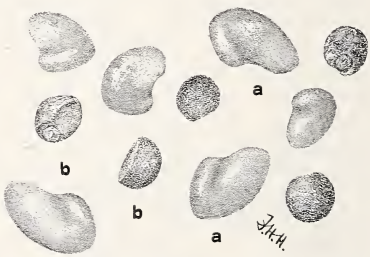

FIGURE 16.—Seeds of *a*, red clover, and *b*, field dodder, showing relative sizes. (Enlarged.)

SWEETCLOVER AND SOURCLOVER

Once considered useless weeds, both white sweetclover (*Melilotus alba*) and yellow sweetclover (*M. officinalis*) have become forage crop plants of major importance throughout the Corn Belt and north to the Canadian border. Sweetclover seed (fig. 17, *a* and *b*) may be distinguished from the true clovers, alfalfa, and bur-clover

[7] HARRINGTON, GEORGE T. HARD CLOVER SEED AND ITS TREATMENT IN HULLING. U. S. Dept. Agr. Farmers' Bul. 676, 8 pp. 1915.

by the rather symmetrical oblong shape, with the broad, shallow scar notch near one end. The sides are slightly flattened so that the seed lies flat on a plane surface, and a slight groove or light stripe leading from the scar is usually evident. The color is commonly yellowish, greenish, or light brown, with some seeds showing purple mottling. The surface is dull and smooth, or sometimes faintly roughened. The fresh seed has an odor that is peculiar to sweetclover.

White sweetclover and yellow sweetclover often occur as mixtures, and without the pods the seeds of the two species are not easily distinguished. The purple-mottled seeds are not likely to occur in the white sweetclover on the market at the present time, and their presence in a sample would suggest yellow sweetclover, or a mixture of the two varieties.

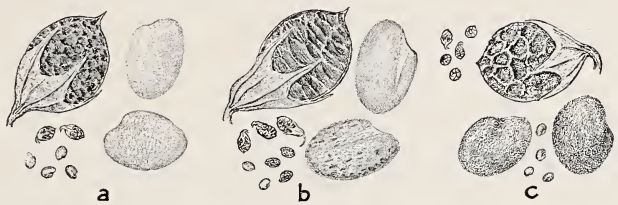

FIGURE 17.—Seeds and pods of three kinds of sweetclover: *a*, White sweetclover; *b*, yellow sweetclover; *c*, sourclover. (Enlarged and natural size.)

The pods of the two species are readily distinguished. The pod of white sweetclover shows a coarse, irregular network of ridges, and the papery, five-toothed calyx and curved stem often remain. (See fig. 17, *a*.) The pod of yellow sweetclover has somewhat coarser ridges, which extend more distinctly crosswise of the pod. The pod narrows at the base, resulting in a constriction just below the teeth of the calyx. (See fig. 17, *b*.)

Seed of sweetclover appears in the market both with and without the pods, being designated in the trade as "hulled" or "unhulled." Sweetclover seed in the hull and even hulled seed that has not been specially scarified usually contains a very high percentage of hard seeds. These hard seeds when planted in the field probably will germinate only if planted in the fall and winter so as to have the scarifying effect of the freezing weather.

White sweetclover and yellow sweetclover, being produced in the same general region, carry essentially the same weed-seed impurities. The other crop seeds commonly present are red clover, alsike clover, timothy, and alfalfa.

Sourclover or yellow melilot (*Melilotus indica*) is extensively grown as a cover crop, its production being principally in Arizona, California, and Louisiana. It also has some value as forage. Sourclover seed may be distinguished from that of white and yellow sweetclover by its olive-green color, the absence of the shallow groove or white line below the scar, and the distinctly roughened or finely tubercled surface, which grates when the seeds are rubbed together. (See fig. 17, *c*.)

Incidental seeds of spotted bur-clover or of California bur-clover (fig. 9, *b* and *c*) may be found in samples of sourclover.

Lespedeza

Of the lespedezas now in cultivation, two species are annual plants: Common lespedeza (*Lespedeza striata*), with its two varieties Tennessee 76 and Kobe; and Korean lespedeza (*L. stipulacea*) and its varieties Early Korean, Late Korean, and Harbin. One perennial species, known as sericea (*L. cuneata*), is of commercial importance.

Commercial seed of lespedeza consists chiefly of seed enclosed in the pods, with a variable proportion of free seeds (fig. 18, *c*) which have become hulled in the process of harvesting and cleaning. The single-seeded pods (fig. 18, *b*) are oval in shape, somewhat flattened, more or less hairy, and with a more or less evident network of slender lines or veins. Normally, the pod is surrounded by a persistent outer circle of floral leaves (the calyx) (shown in fig. 18, *a*), at the base of which are attached three scalelike leaflets (bracts). In the cleaned seed, as may be expected, the calyxes and bracts have been broken away from a portion of the pods.

FIGURE 18.—Seeds and pods of lespedeza: *A*, Common; *B*, Kobe; *C*, Korean; *D*, sericea. Views *a*, *b*, and *c* show the seeds 5 times natural size. View *d*, seeds natural size.

The pods of common lespedeza as well as those of the two varieties Tennessee 76 and Kobe are light brown in color, the network of lines usually distinct. Both pod and calyx are more or less hairy, the calyx being one-half to three-fourths the length of the pod, the lobes short pointed. The hulled seeds are smooth and lustrous, with various light-colored mottling on a purplish background, with occasional seeds uniformly purplish brown.

The seed of common lespedeza appears to be indistinguishable from that of its variety Tennessee 76. Likewise, certain individual seeds of common lespedeza and those of the variety Kobe cannot be identified with certainty. However, small bulk portions of Kobe and of common lespedeza appear to be distinguishable, the pods and calyxes of Kobe being, in general, larger in size and lighter in color. The comparative size of the two kinds is shown in figure 18.

Pods of Korean lespedeza are grayish brown, with a distinct network of dark-colored lines or veins, the surface sparingly hairy. The calyx is one-third to one-half the length of the pod, thin and frail, straw-colored or light brown, not hairy, the lobes with rounded tips. The hulled seed is lustrous, very dark purple, not flecked or mottled, with the scar within a light-colored area near one end of the seed (fig. 18, *c*). The scar notch is shallower than in the other varieties of lespedeza here described, and the seed is more regularly elliptical in outline.

Pods of sericea lespedeza are dull reddish brown, the edges of the pod densely white hairy, the sides only sparingly hairy, the network of lines indistinct. The calyx, commonly absent in commercial seed, is one-half to three-fourths the length of the pod, cleft nearly to the base, densely white hairy. The bracts are minute, linear, hairy. The hulled seeds are slightly lustrous or dull, green tinged, light olive or light brown, or having small patches of light purple.

Both common and Korean lespedeza have a high percentage of hard seed when tested for germination soon after harvest. It has been found that the number of hard seeds gradually decreases until by January it is reduced to 5 to 15 percent. Usually no further decrease takes place. Sericea lespedeza seed is usually mostly hard seed unless it has been scarified. Unless very carefully done, the scarifying process may injure the seed and result in a high percentage of broken sprouts when the seed germinates.

Vetch

A test of vetch seed consists chiefly in distinguishing the seed of hairy vetch (*Vicia villosa*), common vetch (*V. sativa*), woollypod vetch (*V. dasycarpa*), Hungarian vetch (*V. pannonica*), narrowleaf vetch (*V. angustifolia*), and purple vetch (*V. atropurpurea*), and determining their viability.

Figure 19.—Seeds of six kinds of vetch: *a*, Hairy vetch; *b*, common vetch; *c*, woollypod vetch; *d*, Hungarian vetch; *e*, narrowleaf vetch; *f*, purple vetch. (Enlarged and natural size.)

Hairy vetch seeds are nearly spherical so that they roll readily on a level surface. They are black or brownish in color, with a smooth, velvety surface. The seed scar, usually flush with the surface of the seed, is oblong oval, reddish brown or black, with a white slit lengthwise through the center. A small protuberance of the seed (chalaza) is located nearly the length of the scar distant from the narrower end of the scar, as shown in figure 19, *a*.

The hard seed content of hairy vetch seed is very variable and tends to increase when the seed is stored where it dries out quickly.

Seed of woollypod vetch (fig. 19, *c*) can be distinguished from that of hairy vetch only by a careful examination with a magnifier. The seeds, black or brown, average larger in size and being somewhat compressed, do not roll readily. The surface of the seed scar is depressed below the surrounding surface, which forms a ridge or thick roll around the scar. The scar is generally narrowly ovate, dark or lighter than the surface of the seed, with usually a light stripe along the groove in the middle of the scar. The position of the chalaza is about as in hairy vetch.

Common vetch seeds are variable in size, form, and color. Some seeds are large, compressed, and somewhat angular; others are nearly spherical and smaller. The color varies from cream color to black, brown, gray, or mottled, the surface appearing semipolished rather than velvety. The edges of the scar are depressed as in woollypod vetch, but the scar is usually longer, narrower, and more wedge-shaped. The light-colored margins of the slit in the scar are distinctly raised, sometimes the whole scar area being convex. The small, pointlike chalaza is usually near the narrower end of the scar (fig. 19, *b*).

Hungarian vetch seed is brown, often mottled, variously compressed. It can be distinguished from the other vetches by the position of the chalaza, which is located on the back of the seed, the side opposite the seed scar, indicated by 1, figure 19, *d*.

Seed of narrowleaf vetch (fig. 19, *e*) averages smaller than that of hairy vetch; the color is black or mottled, with a slight luster. The main point of distinction from hairy vetch is the seed scar, which is more wedge-shaped and slightly depressed, with a raised slit through the center. The seeds of this species are not easily distinguished from some of the small-seeded forms of common vetch.

Seeds of woollypod vetch, Hungarian vetch, common vetch, and narrowleaf vetch often occur in varying quantities as incidental seeds in hairy vetch samples. Special attention should be given to detecting their presence in the sample to be tested. Samples of common vetch sometimes contain seed of Hungarian vetch. With practice, the two species may be readily distinguished.

Purple vetch seeds are a dull jet black, circular or broadly oval in outline, flattened, with a conspicuous white appendage attached to the long linear scar. This appendage readily distinguishes the seed from the other vetches here described. (See fig. 19, *f*.)

TESTING SEEDS OF THE MUSTARDS

General Seed Characters

The mustards (*Cruciferae*) include a wide variety of plants, only one of which, winter rape (*Brassica napus*), is used for forage purposes. Certain other species are being used locally for quick cover crops—white mustard (*B. hirta*), black mustard (*B. nigra*), and to some extent, India mustard (*B. juncea*). Some other well-known plants of the mustard group are turnip, rutabaga, cabbage, cauliflower, radish, and the various mustard greens. In general, the seeds are spherical or slightly flattened, and the seed scar appears

as an indistinct spot on the surface. The surface may be smooth and velvety, or finely lined or ridged. The seed in bulk may appear pale yellow, grayish black, reddish, reddish brown, or bronze. There is considerable variation in color of the individual seeds in a sample, and, excepting the yellow-seeded varieties, no one color as a rule distinguishes a species. The testing of seeds of this group by the layman is not likely to be wholly satisfactory because of the difficulty in identifying with certainty the seeds of the different kinds and of distinguishing them from the closely related mustard weeds.

Winter Rape

The seed of winter rape (fig. 20) may generally be recognized by the relatively large size of the individual seeds and by their roundness, allowing them to roll readily on a plane surface. The usual color is steel black, but samples carrying considerable reddish seed are not uncommon. The seed surface as seen under a magnifier shows a somewhat indistinct network of fine lines.

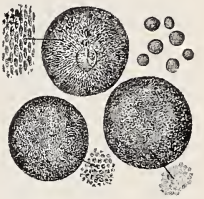

Figure 20.—Seeds of winter rape. (Enlarged and natural size.)

Practically all the seed of winter rape used in the United States has been supplied by foreign markets, principally central Europe and Japan, but some production is now in progress in the Northwest. In recent years the seed has been comparatively free from weed impurities. The foreign seeds most likely to occur are charlock (see fig. 31, *t*), India mustard (see fig. 32, *a*), turnip-rape, and bird rape. The seeds of turnip-rape and of bird rape are smaller, in general, than those of winter rape, but they are difficult to distinguish from certain seeds of winter rape.

White Mustard

Seeds of white mustard are pale yellow in color with an occasional seed light brown. They are slightly flattened, with a finely roughened surface. The seed of white mustard may be confused with the yellow-seeded form of India mustard or with a yellow-seeded form of bird rape. The two latter forms are rather infrequent in the trade, however. Samples of white mustard are, as a rule, free from weed impurities.

Black Mustard and India Mustard

Seeds of black mustard average smaller in size than those of the other species considered here (see fig. 31, *s*, and p. 39, *s*). Seeds of India mustard average a little larger in size than black mustard, and tend to be more spherical (see fig. 32, *a*, and p. 40, *a*). The two species are difficult to distinguish at a low magnification, especially when they occur as mixtures.

These mustards have weedy habits of growth. They seed profusely and, if allowed to mature seed, may become very objectionable weed pests.

TESTING SEEDS OF THE GRASSES

Form and Structure of Grass Seeds

The grass family (Gramineae) includes the common cereals as well as the plants usually recognized as grasses. Most of the grass seeds, also oats and barley, appear in the chaff or hull. That is, the grains or kernels of the seed are covered by the dried chaffy flower scales, one (lemma) larger than the other (the palet or palea) (fig. 21). The difference in size, form, and structure of these scales distinguishes the different kinds of grass seeds.

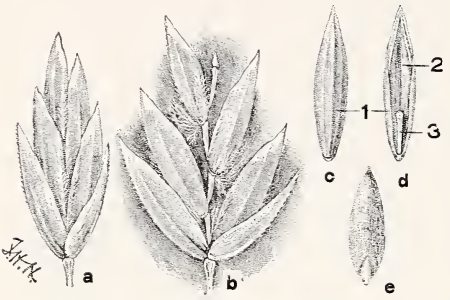

FIGURE 21.—A spikelet and florets ("seeds") of Kentucky bluegrass: *a*, Spikelet as it appears at maturity; *b*, the same having the florets spread apart, showing the jointed rachilla; *c*, back view of a floret, showing the lemma (1); *d*, front view of the floret, showing the edges of the lemma (1), the palet (2), and the rachilla segment (3); *e*, the grain or kernel of the seed.

The seeds are produced in clusters (spikelets). In one group of grasses the clusters contain several seeds arranged along a common axis (rachilla). At maturity the clusters break apart, each seed retaining a piece of the cluster axis (rachilla segment) (fig. 21). As will be pointed out later (p. 29), the type of rachilla segment is an important distinguishing character in certain species. Examples of this class of grass are orchard grass, meadow fescue, ryegrass, bromegrass, and bluegrass. In another class of grasses each cluster contains but a single seed which, therefore, has no rachilla segment. The seeds of proso (broomcorn millet) are a good example of this class, the seed scale (lemma and palea) being hard, smooth, and shining. Part of the seed of foxtail millet, Japanese millet, and bristlegrass (the foxtail weeds) differs structurally from proso only in being covered by two or three additional chaffy scales, which constitute the outer chaff. These features of form and structure are readily recognized when representative seeds are compared under a magnifier.

Corn

The testing of seed corn (*Zea mays*) consists chiefly of the germination test, showing how much of the seed will germinate and with what vigor. If the corn to be used for seed is in the ear and has been selected with reference to variety and in conformity with the recognized type of ear and of kernel best adapted for crop production, only its viability need be tested.

The two types of germinator adapted for this work have already been described (p. 9). After removing sufficient of the butt and tip kernels of the ear to leave on the cob kernels of uniform size, six kernels are removed for test. Of these, two are taken from near the butt, two from the middle, and two from near the tip. Each pair of kernels should be taken from opposite rows, which rows are one-third of the circumference of the ear apart. In this way fairly

representative kernels of the ear are chosen. The kernels are placed side by side, germ side uppermost, in the marked squares of the germinator which are numbered serially, the ears furnishing the kernels for the squares being numbered correspondingly. This is an individual-ear test. Every seed should germinate, thus showing viability of 100 percent. If any of the kernels of an ear fail to germinate, that ear should be discarded. If the germination for any ear is weak, producing inferior sprouts or is unduly slow, the ear should be rejected. The character of the sprouting should be apparent in 5 days.

Flax

The flax plant (*Linum usitatissimum*) belongs to the flax family (*Linaceae*), but for convenience it is here considered with the grasses. Properly cleaned flax seed should be practically free from impurities. Poorly cleaned lots contain many kinds of weed seeds which, in general, include most of those found in millet seed and in wheat. In a test of flax seed special attention should be given to the possible presence of flax dodder. As shown in figure 22, some of these dodder seeds are double and thus fail to pass a sieve that will remove most of the single seeds. Fairly well cleaned lots of flax seed are thus likely to contain these double seeds of dodder. Much of the imported flax seed contains seed of flax dodder. The very destructive nature of this dodder justifies every effort to prevent the introduction of its seed. Seed of falseflax (fig. 31, *p*) is a common weed impurity.

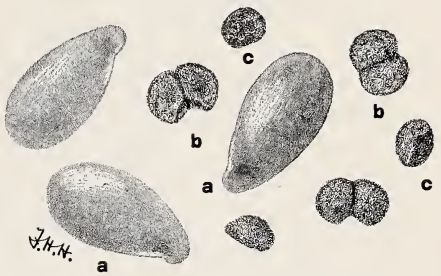

Figure 22.—Seeds of *a*, flax, and of *b*, double flax dodder, and *c*, single flax dodder, showing relative sizes. (Enlarged.)

Flax seeds should be placed on top of the blotter or other substratum for the germination test. The seeds have a mucilaginous seed coat that becomes sticky when wet, and if the seeds are placed between blotters it is difficult to separate the two layers without injury to the sprouting seeds.

Kentucky Bluegrass

The Kentucky bluegrass (*Poa pratensis*) seed in the American market is produced in this country, chiefly in Kentucky and Missouri. Seed in the bulk has a brownish straw color. Individual seeds are canoe-shaped, approximately three thirty-seconds of an inch long, the back of the lemma being sharply angled. A slender ridge on each side of the angle of the lemma is usually evident (fig. 23, *a*). The chief points to be considered in testing Kentucky bluegrass seed are the presence of Canada bluegrass seed as an adulterant and the presence of an undue amount of chaff.

Canada bluegrass (*Poa compressa*) seed has in the past been employed in large quantities as an adulterant of or as a substitute

for Kentucky bluegrass seed. Its seed is very similar to the latter but can be distinguished by means of a magnifier. In general, Canada bluegrass seed in bulk has a somewhat lighter color. Its individual seeds (fig. 23, *b*) are broader, more blunt and papery at the apex, and the sides of the lemma are devoid of the ridges which are distinct in seeds of Kentucky bluegrass (fig. 23, *a* and *b*).

Because it is difficult to remove all the sterile chaff from seeds containing a grain, it will suffice for the home or school tests to remove only the lightest chaff, pieces of stems, leaves, and other inert matter, endeavoring to leave all the grain-bearing seeds with the pure seed. By this method some empty or sterile seeds will also be left with the pure seed. The pure seed and chaff may be separated by placing the weighed sample, a little at a time, on a smooth cardboard tray and then pouring it into another tray, allowing the seeds to roll across the face of the tray. The light chaff is held behind, and the heavier grain-bearing seeds roll off. Carefully repeating the operation two or three times effects a very satisfactory separation. After removing the foreign seeds, the seeds for the germination test are to be counted out from the pure seed separation, the chaffy and grain-bearing seeds being taken indiscriminately.

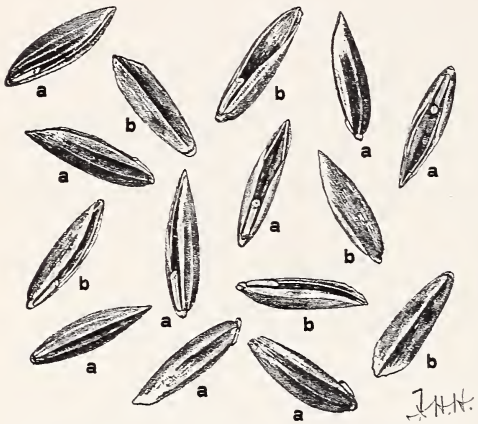

FIGURE 23.—Mixture of seeds of *a*, Kentucky bluegrass, and *b*, Canada bluegrass. The Kentucky bluegrass seeds are broadest at the center, pointed, and have a distinct ridge on each side. Canada bluegrass seeds are mostly broadest near one end, blunt, and smooth on the sides. (Enlarged.)

Kentucky bluegrass seed should be comparatively free from chaff, but the methods of cleaning in use leave from 10 to 20 percent or more of chaff with the pure seed. Some samples show the purity ranging from 80 to 85 percent, but most tests range from 70 to 80 percent, and many fall much lower. The viability ranges from 80 to 90 percent in the best samples, but most tests range from 65 to 80 percent and many fall lower. The method of making the purity test given here tends to give higher purity and lower viability than more carefully made official tests. Most of the sprouts appear within 14 days, others appear from time to time until the 28th day. Because of the chaffy nature of bluegrass and the special handling required to make the germination test, it is usually impractical to make a satisfactory test of Kentucky bluegrass seed in the home or school.

MEADOW FESCUE

Individual meadow fescue (*Festuca elatior*) seeds are boat-shaped, three-eighths to one-half inch long, flattened: the lemma rounded, its apex rather bluntly pointed. The characteristic rachilla seg-

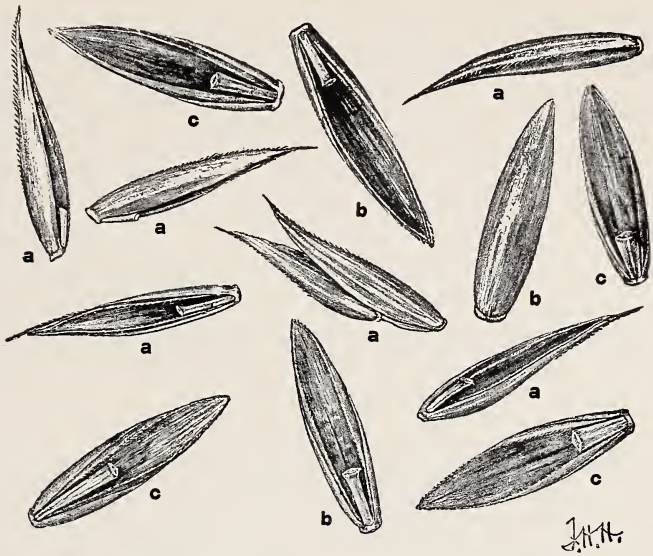

FIGURE 24.—Mixture of seeds of *a*, orchard grass; *b*, meadow fescue; and *c*, perennial ryegrass. The orchard grass seeds are distinguished from the others by their slender, curved form. The meadow fescue and ryegrass seeds are distinguished by the rachilla segment which each bears, that of meadow fescue being slender, cylindrical, with a disklike expansion at the apex; that of ryegrass is usually wedge-shaped, flattened, and scarcely expanded at the apex. (Enlarged.)

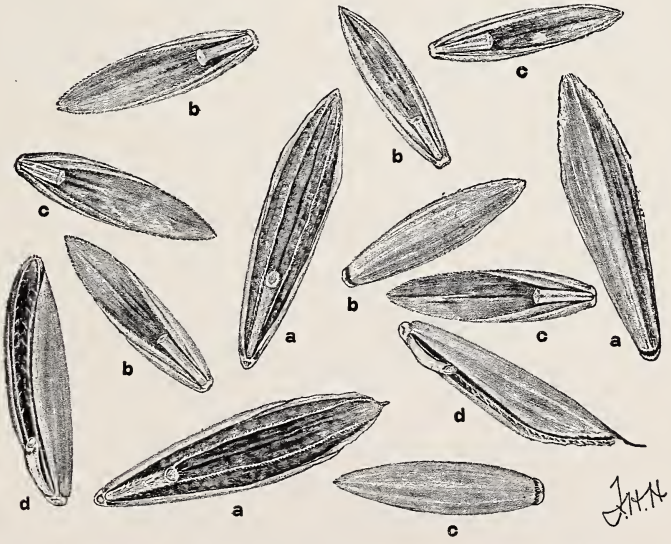

FIGURE 25.—Mixture of seeds of *a*, smooth brome; *b*, meadow fescue; *c*, perennial ryegrass; and *d*, chess or cheat. The bromegrass seeds are distinguished by their greater length and flattened form. The seeds of chess (*d*) are somewhat cylindrical, because they are folded lengthwise. They are thus thicker than the smooth brome seed, and sometimes they are awned. (Enlarged.)

ment is slender, cylindrical, and distinctly expanded at the apex (fig. 24, *b*, and fig. 25, *b*).

Meadow fescue has in the past been adulterated with seed of perennial ryegrass, which is almost identical in form but may be distinguished by the rachilla segment which is usually wedge-shaped, flattened, and scarcely expanded at the apex (fig. 24, *c*, and fig. 25, *c*). The examination of meadow fescue seed for the presence of ryegrass should always be made.

The seed of chess (fig. 25, *d*) is sometimes present in meadow fescue seed. The chess seeds are larger, usually cylindrically folded, and sometimes have a short awn at the apex. The rachilla segment is curved and club-shaped.

Meadow fescue seed usually is comparatively free from meadow fescue chaff, but very poor seed may contain chaff or poorly developed seed of orchard grass.

Millet

The millets used as forage crops in this country represent three distinct kinds of grasses: Proso or broomcorn millet (*Panicum miliaceum*), foxtail millet (*Setaria italica*), Japanese millet (*Echinochloa crusgalli frumentacea*), and the closely related barnyard grass (*E. crusgalli*). (See fig. 26.) The seed test should show which kind is involved.

FIGURE 26.—Seeds representing the three groups of millets: *a*, Proso; *b*, foxtail millet, including the German, golden (or common), and other varieties; *c*, Japanese millet, and *d*, barnyard grass. (Enlarged and natural sizes.)

Seeds of proso (fig. 26, *a*) are mostly free from the brown, papery, loose-fitting chaff; they are broadly oval, robust, highly polished, shining, and tend to roll readily on a plane surface. The color varies in different varieties and includes straw color, light yellow, orange, gray, and dark brown.

Seed of barnyard grass as well as that of Japanese millet is usually enclosed in the light-brown or dark-brown, hairy, sharp-pointed outer chaff. (Compare *c* and *d* in fig. 26.) With this chaff removed, the seed is whitish or gray, smooth, and polished, plano-convex, the convex face strongly arched.

Seed of foxtail millet (fig. 26, *b*) appears both with and without the thin, whitish outer chaff, most of the seeds being free from it. With the outer chaff removed, the seeds present a finely roughened, or stippled, surface which has a slight luster. German millet seeds vary in color from light yellow to golden yellow. They are usually broadly oval, robust, and roll readily. Golden (or common) millet seeds are yellowish in color; oval, but relatively longer in proportion to their width than seeds of German millet, and more smooth and shiny.

Hungarian millet seed consists of a mixture of yellowish seed with seeds of various shades of brown to almost black. The darker seeds are often mottled. The seed of Siberian millet usually carries some orange-colored seeds, which helps to distinguish it from other forms of millet. Manchurian millet seed resembles, in general, that of German millet.

Seeds of foxtail millet, particularly those of golden (or common) millet, are distinguishable from the similar seeds of the weed, green bristlegrass (green foxtail) (see fig. 33, *d*), by their slightly larger size and more polished surface.

In years of domestic crop failure large shipments of millet have been imported for seed. Except in a general way, such as described above, it would be difficult for the layman to distinguish with certainty the different forms of foxtail millet or to establish the source of their origin.

Oats and Barley

Seed of oats (*Avena sativa*) and of barley (*Hordeum vulgare*) may be tested in general as outlined for wheat. In testing oats special attention should be given to the possible presence of seed of wild oat, which can be recognized by its brown color, the brown hairs at the base of the seed, the bent awn at the back, and particularly by the expanded, cup-shaped scar at the base of the seed (see fig. 31, *b*).

In general the weed seeds appearing in wheat may be expected to appear in poorly cleaned oats and barley.

Orchard Grass

Orchard grass (*Dactylis glomerata*) seed is readily identified by the slender, pointed form of the seed in the chaff. The lemma of the seed is angled on the back and is curved to one side toward the apex (fig. 24, *a*). The seeds are three-eighths inch to one-half inch long. Some of the seeds bear the sterile chaff of a second seed (fig. 24, middle, *a*).

The seeds of meadow fescue (fig. 24, *b*) and of perennial ryegrass (fig. 24, *c*) are similar to seeds of orchard grass. They are about the same length as the orchard grass seeds, but are flattened and broader, not curved nor slender pointed. When seen under a magnifier the two kinds may be distinguished by the difference between the rachilla segments, that of meadow fescue being slender, cylindrical, and distinctly expanded at the apex; that of perennial ryegrass usually wedge-shaped, flattened, and scarcely expanded at the apex (fig. 25, *b* and *c*). Both of these kinds of seed have appeared as adulterants of the same lot of orchard grass seed. Orchard grass chaff may be distinguished by its light weight, sometimes to some extent by its light color and by the absence of a grain as observed by pressure.

Orchard grass seed should be carefully mixed before the test sample is taken, because small and relatively heavier impurities are likely to settle to the bottom of the bulk sample. In making a test of orchard grass seed, a great deal of labor is required to separate the empty, chaffy seeds from the grain-bearing seeds. For the home or school test, such seeds may better be left with the grain-bearing seeds and counted indiscriminately for the germination test, in which the true value of the sample will appear. As previously discussed

in the case of chaffy bluegrass, this type of test tends to give the sample a higher purity and a lower viability than the more carefully made official test.

Redtop

Redtop (*Agrostis alba*) seed is offered in the trade under the names "recleaned" or "solid" seed, "unhulled," and "chaff" seed. The application of these terms becomes evident when the structure of the seed is considered. The recleaned or solid seed, also called "fancy," consists (fig. 27) of a mixture of grains covered by the silvery, papery inner chaff (*a*) and free grains (*b*). The recleaned or solid seed is the best matured, purest, and heaviest of the grades of redtop. The unhulled redtop consists chiefly of seed enclosed in the outer chaff (fig. 28, *a*).

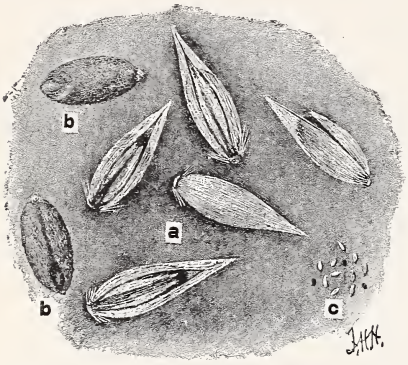

Figure 27.—Seeds of recleaned or fancy redtop: *a*, Different views of seeds having white, papery inner chaff; *b*, two views of a grain, or kernel, with the inner chaff removed; *c*, the same, natural size.

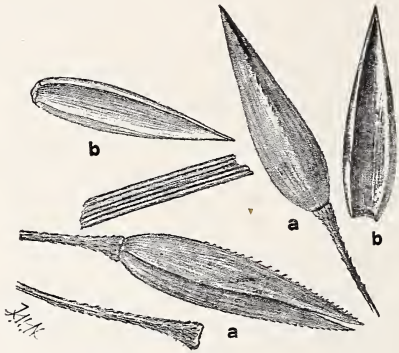

Figure 28.—Chaff of redtop seed: *a*, Whole spikelets usually devoid of seed in chaffy samples; *b*, separated scales of the same; *a* and *b* represent the outer chaff of the seed. (Enlarged.)

This is generally more immature than the recleaned seed. It also is lighter and lower in purity. Chaff redtop is very variable in quality, consisting largely or almost entirely of empty chaff scales (fig. 28, *a* and *b*) and pieces of stems, leaves, and other inert materials. Many samples of chaff redtop contain very little seed.

The recleaned seed is usually comparatively free from impurities but sometimes contains timothy to the extent of severe adulteration.

In making a home or school test of the unhulled and chaff redtop, the lightest chaff may be blown carefully from the heaviest seed of a quantity of seed of known weight. Some seeds will retain the enclosing outer chaff, giving them the appearance shown in figure 28, *a*. Slight rubbing will loosen this outer chaff when it, too, may be blown away, leaving the pure seed in essentially the same condition as shown in the recleaned grade. This seed, after removing the ergot, timothy, and other foreign seeds, may then be weighed and its quantity compared with the quantity of the original test sample. Such a comparison sometimes shows a surprisingly small quantity of true seed present.

The unhulled seed is variable both as to purity and viability. The purity is influenced by the widely variable quantity of broken leaves, ergot, and loose chaff, and the viability varies because of the practically worthless immature and undeveloped grains, which constitute a variable proportion of this quality of seed.

Smooth Brome

Both domestic and imported seed of smooth brome or awnless bromegrass (*Bromus inermis*) are on the American market. This seed should be readily recognized by its large size and thin, boat-shaped form and the light-brown color of the individual seeds. (See fig. 25, *a*.) The large, thin, dark-brown grain of the seed is easily distinguished through the papery palea.

Smooth brome seed should be examined for the presence of meadow fescue (fig. 24, *b*, and fig. 25, *b*); chess or cheat (fig. 25, *d*); quackgrass (fig. 31, *e*); and ryegrass, as in figure 25, *c*, or with a long, slender awn at the apex. Smooth brome often carries seed of wheatgrass, which is so similar to that of quackgrass that the layman is not likely to distinguish them with certainty.

Sudan Grass

Samples of Sudan grass (*Sorghum vulgare* var. *sudanense*) consist of seeds in the hull, with usually a small proportion of hulled grains present. Seeds in the hull are broadest below the middle; hulls glossy, straw-colored or tawny, with occasional seeds tinged with red, reddish brown, or dark brown. There is usually a slight constriction between the base of the seed and the stem (fig. 29, *A*, *a*), but there is no definite line of cleavage present so that the stem rarely breaks off smoothly, and many of the seeds retain a portion of the short stem. In a similar way the two appendages (fig. 29, *A*, *b*) are jaggedly broken off at the tip. The hulled grain is elliptical in outline, light brown in color, occasionally darker.

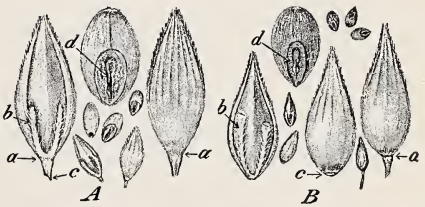

Figure 29.—Seeds of Sudan grass, *A*, and Johnson grass, *B*: *a*, *a*, Point of junction of seed and stem in unhulled seeds; *b*, *b*, the appendages, showing characteristic apexes or tips; *c*, smooth scar of the hull; *d*, *d*, the embryo. (Enlarged and natural size.)

In testing Sudan grass a careful examination should be made for the possible presence of the similar-appearing seeds of Johnson grass (fig. 29, *B*). The seeds of the latter, both with and without the hulls, are noticeably smaller in size than those of Sudan grass and usually darker in color. The prevailing color of the hulls is reddish or dark brown, with some seeds straw-colored, as in Sudan grass. There is a definite suture between the base of the seed and the stem so that the stem breaks off, leaving a smooth, rounded scar at the base of the seed (fig. 29, *B*, *c*). Even when a portion of the stem is retained, a distinct line of cleavage is usually evident with a magni-

fying glass (fig. 29, *B*, *a*). The appendages (fig. 29, *B*, *b*) are smooth and cup-shaped at the top. The hulled grains are predominantly dark, reddish brown in color. In contrast to the elliptical shape of the hulled grains of Sudan grass, grains of Johnson grass are oval in shape, being broader above the middle and often pointed toward the base. The embryo in the seed of Johnson grass is usually relatively narrower than in Sudan grass. (Compare *d*, *d*, in fig. 29.)

Timothy

Timothy (*Phleum pratense*) seed is, as a rule, very pure and not subject to adulteration other than by the use of old seed. The seed is readily identified (fig. 30). It appears both in the chaff (*a*) and as free grains (*b*). Seed in the chaff should have a silvery-white appearance. Free grains are slightly darker and dull. If they are brown a damaged condition is suggested. In addition to the weed seeds found in timothy some lots contain Kentucky bluegrass seed and Canada bluegrass seed (see fig. 23, *a* and *b*) and alsike clover seed (see fig. 10).

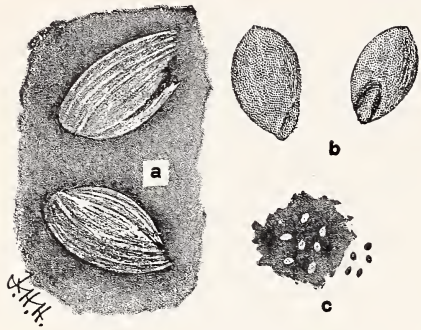

Figure 30.—Seeds of timothy: *a*, Grains in the hull or chaff; *b*, grains removed from the chaff; *c*, the same, natural size.

Wheat

The points to be considered in making a test of wheat (*Triticum aestivum*) are the quantity of shriveled or pinched grains, the presence of bunt, the quantity and character of the weed seeds, and the viability of the seed.

Seed fit for sowing should be plump and well filled. Although the shriveled, small grains should be left with the pure seed in making a test, the germination test will show that they are not satisfactory for seeding purposes. A test of a poor grade of wheat should convince any farmer of the value of fanning mills and screens for cleaning seed wheat.

Grains infected with bunt are somewhat above the average size of the best grains, brown in color, soft, and show a blackened interior when broken open.

Poorly cleaned wheat may carry many of the weed seeds found in forage crop seeds. The white or pinkish bulblets of wild garlic often occur in seed grown in the Eastern States. (See fig. 36, *k*.)

THE IDENTIFICATION OF WEED SEEDS

General Considerations

The identification of seeds requires careful attention to details in order to be satisfactory. The distinguishing marks are often so minute that they are evident only on careful examination under magnification. It will be found that placing the eye close down to the magnifying glass is most satisfactory for detailed study.

Seeds of one kind of plant can usually be distinguished from those of other kinds by such features of form and structure as size, shape, color, position of the seed scar, character of the seed coat, such as dull or glossy, smooth, roughened, or definitely lined, pitted, or tubercled. In the case of grass seeds, the character of the lemma and palea, the type of rachilla, and the awn are all important distinguishing features. Sometimes the scar at the base of the seed is an important character, as in wild oat (fig. 31, *b*) and Johnson grass (fig. 29, *B*). (For structure of the grass spikelet see fig. 21.)

The weed seeds illustrated and described in this bulletin include those kinds designated as noxious under the existing State seed laws, as well as many of the kinds occurring most commonly in crop seeds.[8] The brief descriptions point out the most conspicuous distinguishing characters of the seeds and supplement the illustrations which show the general form and structure, as well as the natural size of the seeds. (See figs. 31 to 38, inclusive.) It will not be possible to see all of the details pictured with the low magnification of the hand lens.

As may be expected, the seeds of any one kind of plant may vary slightly in size, color, or shape, depending somewhat on the growing conditions and on the degree of maturity at time of harvest. The illustrations, as a rule, show the more typical forms of the seeds. With experience in seeing many seeds of a kind it is possible to recognize the usual range of variation from the typical form. It should be borne in mind that the enlarged views of the seeds here illustrated are intended to show the details of seed structure and not the comparative sizes of the seeds. The seed to be identified should be carefully compared with the accompanying illustration of the natural size of the seed, as well as the enlarged view and the corresponding seed description.

The kinds of weed seeds most liable to occur in each of the kinds of crop seeds discussed in this bulletin are listed in the Appendix, table 1. The list is not necessarily complete. It is designed merely to serve as a guide for finding readily the kinds of seeds most likely to be found in seed samples, and other weeds may be added to the list as they appear in the samples examined. It will be observed that certain crop seeds are classed as weeds in this list. To the grower a weed is any plant that is not desirable in the crop seed with which it is found, and some plants may be valuable forage plants in some localities and objectionable weeds in others. Bermuda grass is a familiar example of this class of plants.

Many plants are known locally by more than one English or common name, and in some cases the same name is applied to more than one kind of plant. For example, witchgrass is applied to *Panicum capillare*, a comparatively unimportant weed. In some localities the same name is used for *Agropyron repens* (quackgrass), which is generally considered a noxious weed. And again, bindweed (*Convolvulus arvensis*) is known by at least eight other

[8] Bulletins illustrating and describing the plants of these weeds, with suggested methods of control, may be obtained from the various State experiment stations. Some additional publications are:

GEORGIA, ADA E. MANUAL OF WEEDS. 593 pp., illus. New York. 1914. (Out of print.)

MUENSCHER, WALTER CONRAD. WEEDS. 577 pp., illus. New York. 1935. (Price $6.00.)

common names. This practice leads to a great deal of confusion and uncertainty as to which plant is actually meant. For this reason it is desirable to become familiar with the universally recognized Latin names of plants.

An understanding of the manner in which botanical names are determined is helpful in the use of Latin names. Plants are grouped by botanists into large divisions called families, each of which has some points of structure in common. Thus, the pealike flower and the structure of the pod characterize the legume family (Leguminosae). These major divisions (families) are then divided into groups called genera (singular, genus) because, in each case, some peculiarity in the structure of the flower or fruit sets them off from other groups in that family. For example, the flowers of clover (*Trifolium*) and of alfalfa (*Medicago*) have the pealike flower structure characteristic of the legume family, but the individual flowers of alfalfa are arranged in loose, spikelike clusters, those of clover in heads. To distinguish the two kinds of plants, each is given a different generic name. Within a genus there will be individual plants (species) that are more like one another than they are like any other plant. Using the above illustration, there are different kinds of clover, and a specific name is added to the generic name to indicate which kind is meant, as *Trifolium repens*, white clover; *T. pratense*, red clover.

It is thus seen that, in addition to providing an accepted name, botanical names show plant relationships. This fact may serve as a valuable aid in the identification of seeds. With practice one soon learns to recognize at sight the seed characters of many of the plant families and genera encountered in seed testing. When the genus of the seed to be identified has been determined, the seed may then be compared with the possible species within that genus. Such a procedure is much more satisfactory than searching through a maze of unrelated common names. To illustrate: A seed may be recognized as belonging to the genus *Polygonum* (which includes the knotweeds, cornbind, and ladysthumbs). The seed is then compared with the various species of *Polygonum* that occur in that locality. In some cases it is not possible to determine the species with the low magnification of the hand lens. If the species involved are all relatively unimportant weeds, the name of the genus alone will provide all the information necessary for practical purposes.

Because a plant is often known by different common names in different localities it is often difficult to select any one name that will be recognized everywhere. To aid the reader in recognizing the English or common names here used, the Appendix, table 2, shows the names used throughout the bulletin, together with some of the more generally used local names and their corresponding Latin names. Included in the table are figure references to the seed illustrations and page references to the descriptions of the seeds. An index of the Latin plant names used throughout this publication is given in table 3 of the Appendix.

Distinguishing Characters of Particular Kinds of Weed Seeds

Figure 31.—Weed seeds found in farm seeds. (Enlarged and natural size.)

a, Field sandbur.
b, Wild oat.
c, Chess.
d, Darnel.
e, Quackgrass.
f, Curly dock.
g, Cornbind.
h, Russian-thistle.
i, Corncockle.
j, Evening campion.
k, Bladder campion.
l, Nightblooming catchfly.
m, Cowcockle.
n, Pennycress.
o, Field peppercress.
p, Bigseed falseflax.
q, Littleseed falseflax.
r, Ballmustard.
s, Black mustard.
t, Charlock

a.—Seeds of field sandbur (*Cenchrus pauciflorus*) have somewhat the appearance of small wheat kernels, usually light brown or straw-colored; common in alfalfa seed from the Great Basin region. The spiny burs of this grass reduce the feeding quality of alfalfa hay.

b.—The seeds of wild oat (*Avena fatua*) are similar to seeds of cultivated oats but always have a twisted and bent, brown or straw-colored awn (sometimes broken away) from near the middle, a tuft of light-brown hairs on the rachilla segment and about the characteristic, cup-shaped rim of the scar at the base of the seed; widely distributed and common in seeds of cereals (especially oats) and larged-seeded grasses.

c.—Chess seeds (*Bromus secalinus*) are straw-colored, sometimes greenish or brown when in the chaff (as shown in illustration), the awn at the apex often broken away, the club-shaped form of the rachilla segment distinguishing this from cultivated grass seeds; common in seeds of cereals and large-seeded grasses generally; the reddish-brown, trough-shaped free grains sometimes appear in clover seed.

d.—Darnel seeds (*Lolium temulentum*) are robust, straw-colored, and in the absence of the slender awn somewhat resemble large seeds of meadow fescue and perennial ryegrass; common in seed of cereals, particularly wheat.

e.—Quackgrass seeds (*Agropyron repens*) resemble fescue and ryegrass seeds, but they are usually slenderer, light or yellowish, sometimes greenish colored. Whole spikelets having the two empty scales noticeably joined at the same level at the base of the spikelets (thus differing from most grass spikelets) are frequently found with the individual seeds. Commonly found in seeds of cereals and the coarse grasses. Seeds of quackgrass are very similar to slender wheatgrass and bluestem (western wheatgrass).

f.—Dock seeds are sharply three-angled, reddish brown, smooth, and shining; one of the commonest of the weed seeds found in farm seeds, the reddish-brown ripened flowers (shown at the right of the figure) commonly appearing in the seeds of cereals and coarse grasses. Several kinds of dock seeds occur in farm seeds, the commonest being that of curly dock (*Rumex crispus*). The similar seeds of bitter dock (*Rumex obtusifolius*) are sometimes found. Another kind having smaller seeds, which are rounded instead of pointed at the base, occurs in Chilean red clover seed. (See also fig. 33, *h*.)

g.—Cornbind seeds (*Polygonum convolvulus*) are coarse, three-angled, black when the outer covering is removed; the outer straw-colored, greenish or brown covering (flower scales) may be present or partly or wholly broken away; common in all kinds of coarse farm seeds from all sources, particularly in seed of cereals, millet, and flax.

h.—Russian-thistle seeds (*Salsola kali* var. *tenuifolia*) occur both with and without the gray or light-brown hull (flower scales); the seeds proper have a thin coat covering the slender spirally coiled, greenish embryo; common in alfalfa seed from the Western States and in flax seed.

i.—The seeds of corncockle (*Agrostemma githago*) are black or brown, angular, and covered with fine spiny tubercles; common in seed of cereals, millet, vetch, and flax from all sources.

j.—Evening campion seeds (*Lychnis alba*) are mostly light gray, the surface finely tubercled, the light color distinguishing this kind from the next two; common in imported crimson clover and grass seeds; sometimes found in red clover seed.

k.—Bladder campion seeds (*Silene cucubalus*) are brown or nearly black, flattened, finely tubercled, the tubercles arranged in more or less distinct rows on the sides and in more distinct rows on the edges; occurs frequently in imported grass seed and is sometimes abundant in seed of red and alsike clover grown in the Northern States and in Canada.

l.—Nightblooming catchfly seeds (*Silene noctiflora*) are similar to the preceding, dark gray or brown, finely tubercled, the tubercles not in distinct rows on the sides; very common and often abundant in seed of red and alsike clover grown in the Northern States and in Canada. Figure 33, *t*, shows the seed of the clover catchfly (*Silene dichotoma*), which is common in European red clover and alfalfa seed. Careful comparison of seeds with the illustrations (fig. 31, *j*, *k*, and *l;* fig. 33, *t*) will enable one to distinguish the similar seeds of this group of weeds.

m.—The seeds of cowcockle (*Saponaria vaccaria*) are almost perfectly spherical, black, the surface covered with fine tubular points; very common in seeds of cereals from the West and Northwest; also in millet and flax seeds, sometimes in imported coarse seeds; broken seeds often occur in alfalfa seed.

n.—Pennycress seeds (*Thlaspi arvense*) are oval, flattened, brown, and have concentric ridges on the sides; often found in both domestic and imported seed of cereals, clover, millet, and flax.

o.—Field peppercress seeds (*Lepidium campestre*) are reddish brown, oval, smooth, with a curved line on each side and having one edge flattened so that seed will stand on edge. Compare with the closely related hoarycress (fig. 36, *q*). Common in domestic and imported seed of various clovers, grasses, and cereals.

p and ***q.***—Falseflax seeds as found in farm seeds represent two kinds of falseflax (plants in no way related to the true flax). Seeds of the bigseed falseflax (*Camelina sativa*) (fig. 31, *p*) are light yellow and much larger than those of the other kind; very common in flax seed (hence the common name); also in millet, and sometimes in alfalfa seed. Seeds of littleseed falseflax (*Camelina microcarpa*) (fig. 31, *q*) are much smaller than the others, and darker, being reddish yellow; common in Canadian red and alsike clovers and timothy seed, also in domestic seed.

r.—Ballmustard seeds (*Neslia paniculata*) are unopened, straw-colored, brown or purplish pods, having a network of ridges over the surface and containing a single yellowish seed within; found in seed of cereals, millet, and flax; sometimes in imported seed.

s.—Black mustard seeds (*Brassica nigra*) are small, commonly somewhat oblong, and reddish brown or dark brown, surface pitted, due to a network of ridges; taste distinctly pungent; sometimes found in clover and grass seeds. (Compare with fig. 32, *a*.)

t.—Charlock seeds (*Brassica kaber*) are almost spherical, slightly variable in size, black, reddish brown, or sometimes light brown, the surface comparatively smooth, which distinguishes this seed from seed of other mustards and winter rape; taste somewhat pungent; a frequent impurity of nearly all the common clover, grass, and cereal seeds.

FIGURE 32.—Weed seeds found in farm seeds. (Enlarged and natural size.)

a, India mustard.
b, Hares-ear-mustard.
c, Tumblemustard.
d, Wild carrot.
e, Bindweed.
f, Flax dodder.
g, Clover dodder.
h, Littleseed dodder.
i, Field dodder.
j, Bigseed dodder.
k, Field gromwell.
l, Blackseed plantain.
m, Buckhorn plantain.
n, Common ragweed.
o, Curlycup gumweed.
p, Common sunflower.
q, Oxeye daisy.
r, Canada thistle.
s, Bull thistle.
t, Chicory.

a.—India mustard seeds (*Brassica juncea*) are oblong-spherical, averaging larger than those of charlock; light reddish brown, the surface having a distinct network of fine ridges; taste not pungent; occurring chiefly in seeds of cereals, millets, and flax; sometimes mixed with winter rape seed. (Compare with fig. 31, *s*.)

b.—Hares-ear-mustard seeds (*Conringia orientalis*) are oblong, surface granular, dark brown, and if placed in water develop mucilage, which forms whitish projecting points over the surface on drying; common in seed of cereals, millet, and flax; often in imported seed.

c.—Tumblemustard seeds (*Sisymbrium altissimum*) are very small, flattened, oblong, and yellowish, often with a greenish line along the side.

d.—Wild carrot seeds (*Daucus carota*) are light brown, oval, flattened, nearly plane on one side and ridged lengthwise on the other, the ridges often bearing the remnants of whitish spines; common in red clover and in imported alfalfa seeds, sometimes found in grass seed.

e.—Bindweed seeds (*Convolvulus arvensis*) are coarse, oval, rounded on one side and angular on the other, gray, owing to numerous light-colored raised spots on the surface; common in seeds of cereals, in flax, and in other coarse seeds.

f.—Flax dodder seeds (*Cuscuta epilinum*) are rounded on one side and angular on the other, many of the seeds united together in pairs; soiled gray in color; found only in flax seed; common in imported seed and in some domestic seed.

g.—Clover dodder seeds (*Cuscuta epithymum*) are very small, nearly spherical as a rule, gray or brown; often distinctly pitted; common in imported clover and alfalfa seeds, also in domestic seed; not found in grass seed. The slender spirally coiled embryo of the seed, devoid of two cotyledons, is characteristic of dodder seed.

h.—Littleseed dodder seeds (*Cuscuta planiflora*) are similar in size to seeds of clover dodder, but are more oval and angular in form; colors yellowish, greenish, or purplish, common in alfalfa seeds from the Western States. Of the dodders infesting alfalfa this is the most widely distributed within the United States. Its seed is not found in red clover or grass seeds.

The seed of clover dodder (*Cuscuta epithymum*) and littleseed dodder (*C. planiflora*) are sufficiently small to admit of being wholly removed from clover or alfalfa seed of good grade by the use of a sieve of proper mesh (about 20 to the inch). Clover dodder is a menace in any part of the country. Littleseed dodder appears to be naturally confined to the dry regions of the West.

i.—Field dodder seeds (*Cuscuta pentagona*) are larger than those of clover dodder or of littleseed dodder, rounded on one face and flattened and angular on the other; the characteristic seed scar is a more or less distinct, circular area having a short, raised whitish line in its center; seeds from the Great Basin region gray or pinkish, those from Chile reddish brown; found in both red clover and alfalfa seed, commonest in lespedeza, western-grown alfalfa seed, and in Chilean red clover and alfalfa. The plants are very destructive to clover and alfalfa. The greater part of the field dodder can be removed by the use of a sieve of 20 meshes to the inch.

j.—Seeds of bigseed dodder (*Cuscuta indecora*), the largest of the dodders found in alfalfa, are variable in size; some are not larger than and are similar to the seeds of field dodder; the largest are nearly circular, rounded, and flattened; color gray, greenish, or more commonly brown; scar devoid of the raised whitish line to be seen in field dodder and often indistinct; found only in alfalfa seed produced in

the Western States. This dodder does not appear to thrive in the Eastern States.

k.—Field gromwell seeds (*Lithospermum arvense*) are oval, gray, or brown, and being very hard the name "stoneseed" is often applied to them; found in seed of red and crimson clovers, alfalfa, cereals, and grasses.

l.—Blackseed plantain seeds (*Plantago rugelii*) are small, flat, angular, and black: the scar in the center of one side; common in seed of clover and some grasses; a persistent weed. (Compare with fig. 35, *d*.)

m.—Buckhorn plantain seeds (*Plantago lanceolata*) are smooth, shining, rounded on one side with a deep groove on the other, brown or amber-colored, becoming coated with mucilage when placed in water; one of the commonest impurities of farm seeds. Not abundant in alfalfa seed produced in the Western States. (Compare with fig. 35, *e*.)

n.—Ragweed seeds (*Ambrosia artemisiifolia*) as they commonly occur are somewhat top-shaped, usually with a crown of several teeth or spines; the outer covering is often broken away, the seed then appearing pear-shaped, smooth, and brown; common in American red clover, cereal grain, and lespedeza. (Compare with fig. 38, *p*.)

o.—Curlycup gumweed seeds (*Grindelia squarrosa*) are whitish or straw-colored, variable in form, sometimes wrinkled; found chiefly in alfalfa seed from the Western States.

p.—Common sunflower seeds (*Helianthus annuus*) have the form and the striped, mottled appearance familiar in the cultivated sunflower seeds, but are much smaller; common in alfalfa seed and other seeds from the Western States.

q.—Oxeye daisy seeds (*Chrysanthemum leucanthemum*) are very small, but are readily distinguished by the 10 slender, white ridges which extend from end to end, one end usually bearing a knoblike projection; found frequently, but usually not abundant, in clover seed and small grass seed.

r.—Canada thistle seeds (*Cirsium arvense*) are smooth, light brown, straight or curved, having a cuplike rim at one end, a projecting point often within the rim; found in clovers and grasses.

s.—Bull thistle seeds (*Cirsium lanceolatum*) are larger than those of the Canada thistle, light colored, striped lengthwise with brown, the rim at one end often yellowish; common in red clover, alfalfa, and grass seeds.

t.—Chicory seeds (*Cichorium intybus*) are brown or straw-colored, usually mottled, the crown scales at the broader end sometimes rubbed away; common in imported clover, alfalfa, and certain kinds of grass seeds, less frequent in American-grown seed.

FIGURE 33.—Weed seeds found in farm seeds. (Enlarged and natural size.)

a, Crabgrass.
b, Witchgrass.
c, Yellow bristlegrass.
d, Green bristlegrass.
e, Velvet grass
f, Soft chess.
g, Sedge.
h, Sheep sorrel.
i, Knotweed.
j, Pale ladysthumb.
k, Ladysthumb.
l, Lambsquarters.
m, Wedgescale orach.
n, Redroot amaranth.
o, Spreading amaranth.
p, Corn spurry.
q, Little starwort.
r, Chickweed.
s, Big mouse-ear chickweed.
t, Clover catchfly.

a.—Crabgrass seeds (*Digitaria sanguinalis*) usually bear the outer chaff, which is often soft-hairy, one scale as long as the seed and distinctly three-ridged, the other half the length of the seed; straw-colored, brown, or purplish; common in seeds of clovers, alfalfa, lespedeza, and grasses; plants sometimes very troublesome. (See also fig. 36, *g*.)

b.—Witchgrass seeds (*Panicum capillare*) occur both with and without the outer chaff, which is lance-shaped, smooth, and brown; seeds freed from the chaff are oval, light gray or dark gray, smooth, and polished; common in seeds of clovers, alfalfa, lespedeza, and grasses; plants widely distributed; comparatively unimportant.

c.—Yellow bristlegrass seeds (*Setaria lutescens*) are oval, flat on one side and arched on the other, chaff straw-colored, light brown, or greenish, as long as the seed on the flat face, a half-length scale on the arched face; the light-colored or dark-colored seed within the chaff distinctly ridged crosswise on the arched face; often free from the outer chaff; common in many kinds of farm seeds.

d.—Green bristlegrass seeds (*Setaria viridis*) are oval, convex on both faces, the whitish or straw-colored outer chaff as long as the seed on both faces; seed within the chaff straw-colored, gray, or brown, the darker seeds often mottled, the surface finely roughened and dull; common in many kinds of farm seeds. Both yellow and green bristlegrass are widely distributed summer weeds occupying valuable space in crops. Green bristlegrass seeds are distinguished from seeds of foxtail millet by their smaller size and rough, dull surface. (Compare with fig. 26, *b*.)

e.—Velvet grass seeds (*Holcus lanatus*) usually appear in the chaff, which is thin, oval, and straw-colored, the surface covered with fine, stiffish hairs; a single oval, shining seed usually found within the chaff; a common impurity of coarse grass seeds.

f.—Soft chess seeds (*Bromus mollis*) are lance-shaped, usually much flattened, straw-colored, the lemma awned at its apex, its back usually wrinkled, the palea and grain shorter than the lemma; common in imported coarse grass seeds; widely distributed in the United States, but not an important weed except on the Pacific coast.

g.—Sedge seeds (*Carex* spp.) when covered by the chaffy hull are flask-shaped, straw-colored, brown, or greenish, flattened and thin with respect to the several kinds found in farm seeds; seeds freed from the outer chaff are oval, lens-shaped, and light brown; common in grass seeds, particularly bluegrass seed; plants comparatively unimportant.

h.—Sheep sorrel seeds (*Rumex acetosella*) are small, oval, three-angled, the outer chaffy hull dull reddish brown; seeds freed from the hull are reddish brown, smooth, and polished; found in farm seed both with and without the hull; a common impurity, appearing in seeds such as clover, grasses, poorly cleaned cereals, and millet. Often a troublesome weed. (Compare with fig. 31, *f*.)

i.—Knotweed seeds (*Polygonum aviculare*) are sharply oval, three-angled, dull reddish brown, with a portion of the brown chaffy covering remaining at the broader end; common in clover seed, lespedeza, and grass seed; plants usually of minor importance as field weeds.

j.—Pale ladysthumb seeds (*Polygonum lapathifolium*) are nearly circular, flattened, and chestnut brown when freed from the reddish brown chaffy covering; common in seed of coarse grasses, cereals, and flax. The plants grow chiefly in moist places and are not troublesome on uplands.

k.—Ladysthumb seeds (*Polygonum persicaria*) are usually free from the chaffy covering and are then black, shining, broadly oval, and flattened, or sometimes three-angled; common in various kinds of

farm seeds, particularly American-grown red clover and lespedeza. The habit of the plant is similar to that of the preceding knotweeds, to which it is closely related. This plant is common on dry uplands.

l.—Lambsquarters seeds (*Chenopodium album*) are small, lens-shaped, dark brown or black, and shining, sometimes found within a chaffy covering of five scales; common in all kinds of farm seeds, particularly clover and grass seeds; a well-known weed of gardens, cultivated fields, and meadows.

m.—Wedgescale orach seeds (*Atriplex truncata*) are thin, triangular or wedge-shaped, veined, straw-colored or purplish, their two scales enclosing a single small seed; found in American-grown alfalfa, not appearing in imported seed.

n and ***o.***—Amaranth (pigweed) seeds are lens shaped, black, and highly polished. Seeds of redroot amaranth (*Amaranthus retroflexus*) (fig. 33, *n*) are oval in outline; those of tumble amaranth (*A. graecizans*) are somewhat smaller and nearly circular in outline; and seeds of spreading amaranth (*A. blitoides*) (fig. 33, *o*) are much larger and nearly circular, the sides being strongly convex. Seeds of redroot amaranth and of tumble amaranth, common in various kinds of farm seeds, particularly clover, are not easily distinguishable. Spreading amaranth is native in the Western States and its seeds often appear in alfalfa from that region.

p.—Corn spurry seeds (*Spergula arvensis*) are very small, black, and nearly spherical. A narrow light-colored rim encircles the seed and serves to distinguish it from other weed seeds. Some seeds are flecked with whitish particles; common in imported clover seed.

q and ***r.***—Chickweed seeds are small, mostly brown, nearly circular, and flattened; one kind, little starwort (*Stellaria graminea*) (fig. 33, *q*), common in clover seed imported from Europe, has numerous interlacing wrinkles covering the surface. The other kind, chickweed (*S. media*) (fig. 33, *r*), has the surface covered with individual tubercles arranged in more or less distinct rows; found in both imported and domestic clover seed, also a common weed in lawns, gardens, and thin meadows.

s.—Big mouse-ear chickweed seeds (*Cerastium vulgatum*) are minute, flattened, wedge-shaped, tubercled, and distinctly reddish brown; common in small clover and grass seeds; sometimes a troublesome weed in lawns.

t.—Clover catchfly seeds (*Silene dichotoma*) are very similar to those of evening campion (fig. 31, *j*), bladder campion (fig. 31, *k*), and nightblooming catchfly (fig. 31, *l*), but differ in that they have the tubercles on each face of the seed arranged in a few distinct rows. These kidney-shaped brown seeds often appear in European-grown red clover and alfalfa seed.

FIGURE 34.—Weed seeds found in farm seeds. (Enlarged and natural size.)

a, Creeping buttercup.
b, American peppercress.
c, Shepherds-purse.
d, Strawberryweed.
e, Mignonette clover.
f, Black medic.
g, Birdsfoot trefoil.
h, Cutleaf cranesbill.
i, Dovefoot cranesbill.
j, Small cranesbill.
k, Alfilaria.
l, Nodding spurge.
m, Spinemallow.
n, Evening-primrose
o, Red pimpernel.
p, European stickseed.
q, Forget-me-not.
r, Vervain.
s, White vervain.
t, Blue vervain.

a.—Creeping buttercup seeds (*Ranunculus repens*) are oval, flattened, brown or reddish brown, with a lighter rim, and have a prominent, straight, or slightly curved beak; common in imported crimson clover, meadow fescue, and ryegrass seeds; also found in domestic seed.

b.—American peppercress seeds (*Lipidium virginicum*) are oval, flattened, thin, reddish yellow, and have a curved groove on each face; common, and sometimes abundant, in clover and grass seeds, particularly in timothy; a widely distributed annual weed of waysides, gardens, and meadows.

c.—Shepherds-purse seeds (*Capsella bursa-pastoris*) are minute, reddish yellow, oblong, and flattened, with two more or less distinct grooves on each face; common in seeds of white, alsike, and poorly cleaned red clovers. (Compare with fig. 36, *p.*)

d.—Strawberryweed seeds (*Potentilla monspeliensis*) are minute, straw-colored, oval, and lens-shaped, the faces bearing curved and forked ridges; common in alsike clover and timothy.

e.—Mignonette clover (low hop clover) seeds (*Trifolium procumbens*) are minute, elliptical, yellowish, the surface smooth and shining; common in poorly cleaned clover seed. Seeds of suckling clover (*T. dubium*), also known as hop clover, are similar to mignonette clover.

f.—Black medic seeds (*Medicago lupulina*) are oval with a projecting point on the edge, yellowish brown, or tinged with green (see also figs. 7 and 8). Found in clover and grass seeds. Mature, black, oval pods or immature green pods are common in coarse grass seeds. The plants are widely distributed here and in foreign countries.

g.—Birdsfoot trefoil seeds (*Lotus corniculatus*) are small, nearly spherical, brown, and often mottled; frequently found in imported clover and alfalfa seeds; also cultivated to some extent.

h, i, and ***j.***—Cranesbill seeds as commonly found in farm seeds represent three kinds of plants. Seeds of one kind, cutleaf cranesbill (*Geranium dissectum*) (fig. 34, *h*), are oblong and pitted, having a whitish or light-brown network over a darker brown background, which readily distinguishes them from other seeds; common in imported crimson clover and coarse grass seeds. Another kind, dovefoot cranesbill (*G. molle*) (fig. 34, *i*), has smaller, smooth, rounded seeds, which are often covered by a brown hull bearing several diagonal ridges on each side; often found in imported clover and grass seeds. A third kind, small cranesbill (*G. pusillum*) (fig. 34, *j*), has more oval, smooth seeds, some of which are covered by a somewhat flattened, finely hairy hull; found in imported clover and grass seeds. Seeds of these three kinds of cranesbill occur also in domestic seed, particularly from the Pacific Northwest.

k.—Alfilaria seeds (*Erodium cicutarium*) are somewhat club-shaped, smooth, brown, and often covered by a sharp-pointed, brown, hairy hull; found in clover, alfalfa, and grass seeds; commonest in imported seed.

l.—Nodding spurge seeds (*Euphorbia preslii*) are steel gray or dark brown, oval, and somewhat four-angled, the angles lighter-colored, with one of the angles bearing a slender, black line; a few cross ridges between the angles. Common in American red clover seed.

m.—Spinemallow seeds (*Sida spinosa*) are brown, rounded on one side, angular on the other, and notched at the broader end; common in American-grown red clover seed; the forked, often netted-veined seed vessels (shown at right-hand side of figure) sometimes appear in poorly cleaned clover, but are more common in grass seeds. (Compare with fig. 37, *e.*)

n.—Evening-primrose seeds (*Oenothera biennis*) are small, reddish brown and angular, prismatic, or curved; the corners are thin-edged, the faces finely grooved; common in timothy and sometimes found in clover seed.

o.—Red pimpernel seeds (*Anagallis arvensis*) are small, three-angled, and reddish brown or black; surface finely roughened or sometimes partly smooth; somewhat resemble seeds of sorrel in the chaffy covering (fig. 33, *h*); very common in imported clover and alfalfa seeds, often in grass seed; also occurs in seed from the Pacific Northwest.

p.—Seeds of European stickseed (*Lappula echinata*) are small, oval, brown burs having many barbed prickles; when in clover, most of the prickles are usually broken away; when in grass seeds, some or all of the prickles are usually uninjured; found in red clover, coarse grasses, millet, cereals, and flax; often in seed imported from Europe.

q.—Forget-me-not seeds (*Myosotis arvensis*) are small, black, shining, oval, rounded on one face, and angled on the other; common in imported clover and grass seeds, sometimes in domestic seed.

r, s, and ***t.***—Vervain seeds are oblong, reddish or dark brown, veined on one side, angled and often gray on the other. One kind, vervain (*Verbena officinalis*) (fig. 34, *r*), has a distinct network of ridged veins on the back, the surface between the veins shining; common in European clover and alfalfa seeds. The other two kinds of vervain commonly found in farm seeds have indistinct veins on the back which is dull, one of them, white vervain (*V. urticifolia*) (fig. 34, *s*), being comparatively broad and brown; the other, blue vervain (*V. hastata*) (fig. 34, *t*) being slender and reddish in color; seeds common in American-grown clover seed.

FIGURE 35.—Weed seeds found in farm seeds. (Enlarged and natural size.)

a, Catnip.
b, Selfheal.
c, Roundleaf toadflax.
d, Rippleseed plantain.
e, Bottlebrush plantain.
f, Paleseed plantain.
g, Fieldmadder.
h, Catchweed.
i, Toothed cornsalad.
j, Italian cornsalad.
k, Sumpweed.
l, Black-eyed-susan.
m, Mayweed.
n, Field camomile.
o, False-camomile.
p, Cornflower.
q, Spotted cats-ear.
r, Oxtongue.
s, Hawkweed picris.
t, Orange hawkweed.

a.—Catnip seeds (*Nepeta cataria*) are oval, dark reddish brown or darker, smooth and dull, readily distinguished by the two white scar spots, side by side at one end of the seed; common in clover seed, particularly Canadian-grown alsike and red clover.

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b.—Selfheal seeds (*Prunella vulgaris*) are light brown, oval, with a characteristic whitish appendage at the pointed end, faint dark lines traversing the faces and edges; one of the commonest impurities of both domestic and imported clover and grass seeds.

c.—Roundleaf toadflax seeds (*Linaria spuria*) are very small, oblong, having a light-brown, wrinkled surface; plants not evidently important, but the seeds, as common impurities of imported clover seed, indicate the foreign origin of the lots containing them.

d.—Rippleseed plantain seeds (*Plantago major*) are similar to those of blackseed plantain (fig. 32, *l*), but are smaller, greenish or brown, the surface having slender, wavy dark lines; common in poorly cleaned clover and grass seed.

e.—Bottlebrush plantain seeds (*Plantago aristata*) are similar to those of buckhorn (fig. 32, *m*), but they are broader, dull reddish brown, and the broad groove on one face is bordered by a white stripe; the rounded face is crossed near its center by a shallow groove; common in American-grown red clover seed; sometimes found in alfalfa and grass seeds and occasionally in imported seed.

f.—Paleseed plantain seeds (*Plantago virginica*) are light brown, oval, rounded on one face, and broadly grooved on the other; found in clovers and grasses.

g.—Fieldmadder seeds (*Sherardia arvensis*) are oval; reddish brown or dark brown, with numerous white glandular hairs which give the seed a gray, scurfy appearance; some seeds with three frail, whitish teeth, others devoid of the teeth; common in seed of clover, alfalfa, and grasses; confined chiefly to imported seed.

h.—Catchweed seeds (*Galium aparine*) are coarse, circular, one face rounded, the other depressed in the center; the surface is covered with hair-bearing tubercles from which the hairs may be more or less rubbed away; the entire outer surface is sometimes rubbed away, leaving the seed smooth and brown; common in seed of coarse grasses, millet, cereals, and flax; a common impurity of imported seed.

i and ***j.***—Seeds of cornsalad representing two kinds commonly appear in clover imported from Europe. They are brown; one kind, toothed cornsalad (*Valerianella dentata*) (fig. 35, *i*), is slenderly oval and nearly smooth, the other, Italian cornsalad (*V. eriocarpa*) (fig. 35, *j*), being broader and usually more or less covered with white hairs. The presence of these seeds in clover indicates its foreign production.

k.—Sumpweed (poverty-weed) seeds (*Iva axillaris*) are oval and dull brown, straight or somewhat curved. They occur in red clover and alfalfa seed from the Western States; not found in foreign-grown seed.

l.—Black-eyed-susan seeds (*Rudbeckia hirta*) are minute, black, prismatic, finely ridged lengthwise and four-angled; found chiefly in timothy seed.

m.—Mayweed seeds (*Anthemis cotula*) are oval or club-shaped, straw-colored or brown, ridged lengthwise, the ridges more or less distinctly tubercled; very common in both domestic and imported seed of clover and grasses.

n.—Field camomile seeds (*Anthemis arvensis*) are prismatic, some broad and deeply grooved lengthwise, others slender and lightly

grooved or smooth; color whitish, light brown or dark brown; common in domestic and imported clover and grass seeds.

o.—False-camomile seeds (*Matricaria inodora*) are prismatic, the surface rough and black, one face having three prominent brown ribs, the other showing two of these ribs and a partial third rib; common in poorly cleaned clover seed and grass seed, particularly the seed of sweet vernalgrass imported from Europe.

p.—Cornflower seeds (*Centaurea cyanus*) are easily recognized by the bluish color of the body of the seed and the tawny color of the brush of bristles each bears; common in both domestic and imported coarse seeds, including red clover, crimson clover, grasses, cereals, millet, and flax. (Compare with fig. 38, *d*, *e*, *f*, *h*.)

q.—Spotted cats-ear seeds (*Hypochaeris radicata*) are slender, reddish brown, rough, and sometimes bear a slender beak tipped by a brush of whitish bristles; found in clover seed and grass seed, a common impurity of imported seed.

r.—Oxtongue seeds (*Picris echioides*) are mostly lance-shaped, reddish yellow, the surface having dark transverse lines, the margin at the broader end of the seed roughened (as shown at the left of the figure); a part of the seeds whitish, curved, the inner curved edge white hairy (shown at the upper right hand of the figure); occurs in red clover and alfalfa seed imported from Europe; also found in domestic-grown seed from the Southwest.

s.—Hawkweed picris seeds (*Picris hieracioides*) are reddish brown, straight or curved, bearing fine transverse, dark-edged ridges, the faces of the seed having one or two slender grooves lengthwise; frequently found in imported red clover and alfalfa seed.

t.—Orange hawkweed seeds (*Hieracium aurantiacum*) are small, black, cylindrical, ridged lengthwise, pointed at one end, the opposite end bearing a short brush of fine, white bristles; common in grass seed. The seeds of several kinds of hawkweed are similar. The orange hawkweed and hairy king-devil (yellow paintbrush) are becoming troublesome weeds in the Northeastern States.

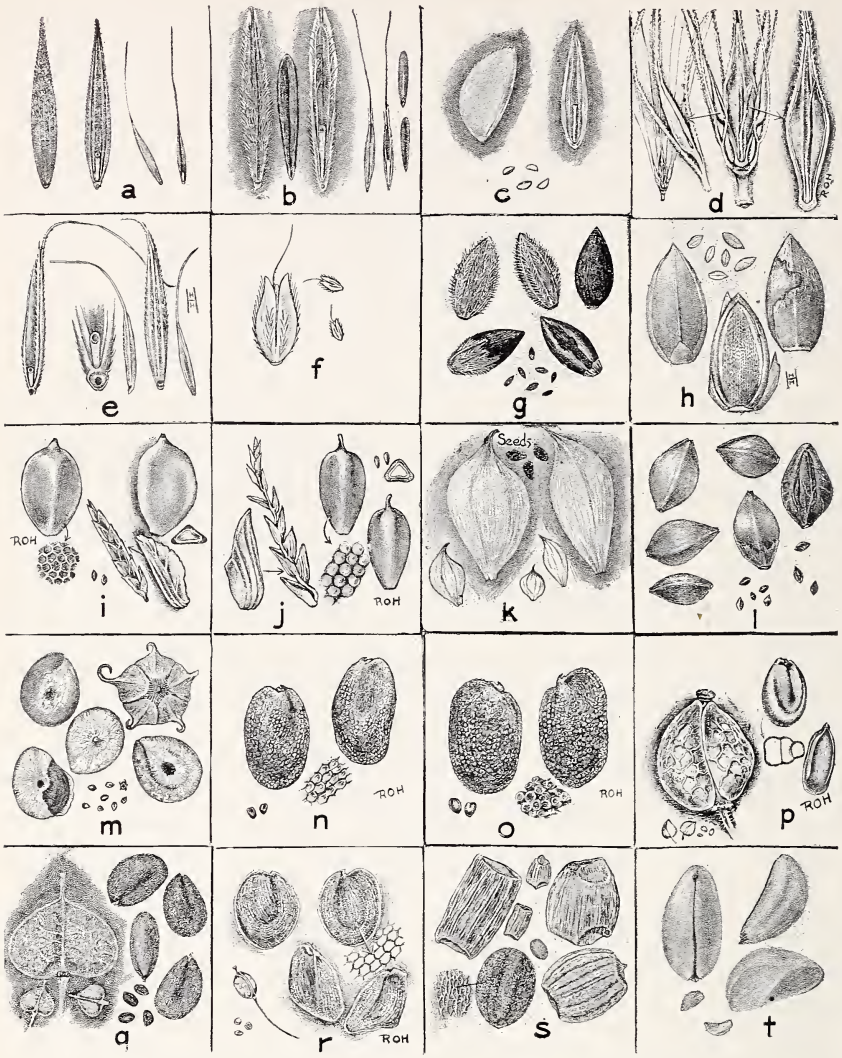

FIGURE 36.—Weed seeds found in farm seeds. (Enlarged and natural size.)

a, Rattail fescue.
b, Downy chess.
c, Bermuda grass.
d, Foxtail barley.
e, Canada wild-rye.
f, Water foxtail.
g, Smooth crabgrass.
h, Knotgrass.
i, Nutgrass.
j, Chufa.
k, Wild garlic.
l, Silversheath knotweed.
m, Bassia.
n, Bitter wintercress.
o, Early wintercress.
p, Perennial peppercress.
q, Hoarycress.
r, Austrian fieldcress.
s, Wild radish.
t, Wild rose.

a.—Seeds of rattail fescue (*Festuca myuros*) are brownish straw-colored, slender, long pointed, terminating in a long fine awn; lemma with short rough bristles toward the tip, palea sometimes almost obscured by the edges of the lemma; rachilla threadlike, with a

slightly expanded tip. Found in seeds of clovers and grasses, particularly from the Northwest and North Central States; also in imported seed.

b.—Downy chess (*Bromus tectorum*) seeds are light straw-colored or reddish, thin and slender, flattened out slightly toward the tip; lemma covered with fine downy hairs, the long fine awn usually broken away; rachilla slender, club-shaped. Occurs in clover, alfalfa, and grasses throughout the Western States.

c.—Bermuda grass (*Cynodon dactylon*). The lemma investing the sharply keeled grain is smooth, grayish or light straw-colored; the laterally flattened grain gives the seed a distinctive half-oval shape. A troublesome weed in cultivated fields, particularly in the South and Southwest.

d.—Foxtail barley (*Hordeum jubatum*). The spikelike heads break up into sections, each of which consists of three spikelets. The middle spikelet is sessile (attached directly on the rachis) and contains a grain, the outer spikelets are set on slender pedicels and contain no grains. Each of the spikelets bears an awn, and just back of each spikelet is a pair of long awns, which represent the empty glumes found in many of the grasses. Thus each section or cluster carries nine long, finely barbed awns. When found in crop seeds these awns are more or less broken, and sometimes only a portion of the cluster is present. May occur in coarse grass seeds.

e.—Seeds of Canada wild-rye (*Elymus canadensis*) are a dull, brownish straw color, or greenish. They may be distinguished from the somewhat similar seeds of quackgrass (fig. 31, *e*) by the long, stout, usually bent awn and the hairy lemma. May occur in the larger seeded grasses. Seeds of the related Virginia wild-rye (*Elymus virginicus*) are a bright yellowish straw color, somewhat glossy, with scattered short, stiff hairs toward the top; the awn usually straight.

f.—Seeds of water foxtail (*Alopecurus geniculatus*) usually retain the two papery, light straw-colored outer glumes with their long, light-colored hairs on the midvein (keel) and side veins. The grain is within a smooth, saclike lemma with the frail straight awn attached below the middle and protruding beyond the two outer glumes. Found in clovers and the smaller grass seeds.

g.—Smooth crabgrass (*Digitaria ischaemum*). The dark-brown seeds are usually evident through the thin, light-colored outer glumes, which are about the same length as the seed. The glumes are densely hairy between the veins, the hairs fine and light-colored. The dark color of the seed, together with the character of the empty glumes distinguishes it from crabgrass (fig. 33, *a*). Occurs in the clovers, lespedeza, and small-seeded grasses.

h.—Seeds of knotgrass, sometimes called wiregrass (*Paspalum distichum*), are pointed, flat on one face, convex on the other. One of the thin outer glumes may have scattered, light-colored hairs toward the top. The shape of the seed and the character of the outer glumes help to distinguish it from the commonly cultivated kinds of *Paspalum*. Occasionally a weed in the Southern States.

i.—Nutgrass (*Cyperus rotundus*) seeds are dull, grayish brown, oval, three-angled, with one face broader than the other two. (See cross-section view.) The surface has a network of fine lines as shown

in the enlarged portion of the drawing, but this is usually evident only under higher magnification. Occurs in cultivated fields in the South and Southwest.

j.—Chufa (*Cyperus esculentus*). The three-angled seeds are a bright, light-brown color, about two-thirds as long as those of nutgrass, slender, ovate or top-shaped, the three sides about equal. (See cross-section view.) The surface has an amber-colored, bubblelike texture, not always visible at low magnification. In gardens and cultivated fields, particularly in the Northeast.

k.—Wild garlic (*Allium vineale*). The elliptical or ovate bulblets, usually somewhat larger than wheat grains, are enclosed in a papery covering, light yellow, pinkish, or almost white in color, and have the characteristic garlic odor when crushed. Seeds are apparently seldom produced. Found in clovers, cereals, and coarse grasses; particularly objectionable in wheat.

l.—The seed of silversheath knotweed (*Polygonum argyrocoleon*) is three-angled, smooth, reddish brown, glossy. Resembles seed of sheep sorrel but is a little larger and more pointed. It can be distinguished from sorrel and dock by the position of the embryo which may be seen by cutting the seed crosswise with a sharp knife or razor blade. The embryo may be seen within one of the angles, whereas in sorrel or dock it lies against one of the flat sides (fig. 31, *f*). Occurs in alfalfa from the Southwest, also from northeastern California.

m.—Seeds of bassia (*Bassia hyssopifolia*), about one-half the size of alfalfa seeds, are ovate in shape, flattened, the thick, rounded margins showing the position of the coiled embryo. The brown seeds are enclosed in a whitish or yellowish papery covering, which may be loosely fitting or partially adherent to the seed, opaque on the upper surface, and usually thinner and translucent on the lower surface, showing the dark color of the seed beneath. Some of the seeds retain the five-lobed calyx (flower scales), each lobe of which bears a hooked spine. In the absence of the calyx with its hooked spines the seeds are not easily distinguished from those of belvedere (*Kochia scoparia*) which, as an escape from cultivation, also occurs as a weed in cultivated fields. Seeds of bassia may occur in alfalfa from the West and Southwest, also Argentina.

n.—Bitter wintercress (*Barbarea vulgaris*). Seeds light brown, broadly oblong, flattened, the two unevenly curved faces usually thickened at the center and sloping to the rounded margins; surface shows a somewhat indistinct network of fine ridges within which may be seen glistening, micalike particles; a fine notch at one end indicates the scar, from which a slight groove extends for a part of the length of the seed. Commonly found with seed of clovers and grasses.

o.—Early wintercress (*Barbarea verna*). Seeds about twice the size of bitter wintercress, broadly oval or oblong, flattened and curved much as bitter wintercress; seed surface is covered with a thin, silvery or yellowish tissue, giving the seed a roughened honeycomb appearance with a slightly metallic glisten. This thin layer of tissue has a tendency to split and peel off in spots, showing the dark-brown, reticulated seed surface beneath. Found chiefly in American-grown clovers and grass seeds.

p.—Seeds of perennial peppercress (*Lepidium latifolium*), because of their similarity to those of shepherds-purse (fig. 34, *c*), may easily pass detection. The seeds are wider in proportion to their length and more oval in outline than the narrow, oblong seeds of shepherds-purse. One edge of the seed is slightly thicker than the opposite edge. (See cross-section view.) At the present time the weed is locally established on the Pacific coast. Seed may occur in the clovers and alfalfa, also in imported seed.

q.—Hoarycress (*Lepidium draba*) and its variety known as lens podded peppercress have seeds that are reddish brown, oval to broad oval, slightly flattened, surface coarsely granular, usually with slight vertical grooves on each side. The seeds are not easily distinguished from the closely related ballcress (*Hymenophysa pubescens*). At the present time hoarycress is more widely distributed than either ballcress or lens podded peppercress. Occurs in alfalfa and red clover chiefly from the Northwestern and Pacific Coast States, also in imported seed. Compared with field peppercress (*L. campestre*) (fig. 31, *o*), it will be observed that the margins of the seed are rounded; those of field peppercress are flattened on the thicker margin so that the seed will stand on edge.

r.—Austrian fieldcress (*Rorippa austriaca*). Seeds in general are roughly heart-shaped, but being tightly compressed in the rounded pod there is great variation in shape; the color is light reddish brown, sometimes yellowish; the coarse reticulations on the surface scarcely visible at a low magnification. At the present time the weed is established locally on the Pacific coast and in the North Central States. Because of its small size it would be likely to occur only with the finer grass seeds. Other species of *Rorippa* are found in bentgrass, but these are somewhat smaller, the surface reticulations correspondingly finer, the unrubbed seeds gray or yellowish in color.

s.—Seeds of wild radish (*Raphanus raphanistrum*) are reddish brown, slightly flattened, the surface showing a faint network of fine lines. The 2- to 8-seeded pods are constricted between the seeds when mature and tend to break apart at these points, as shown in the illustration. It is not unusual to find portions of the pods in a seed sample. At a low magnification the seeds are not easily distinguished from those of the garden radish. May occur in the clovers, alfalfa, and coarse grass seeds.

t.—Wild rose (*Rosa* spp.). The berrylike fruit, containing several seeds, varies in color from orange to bright red. The seeds, about the size of plump wheat grains, or larger, are light brown, hard and nutlike. Commonly found in oats and wheat from the Great Plains.

FIGURE 37.—Weed seeds found in farm seeds. (Enlarged and natural size.)

a, Tiny vetch.
b, Camelthorn.
c, Punctureviné.
d, Leafy spurge.
e, Alkali mallow.
f, St. Johnswort.
g, Scarlet gaura.
h, Wavyleaved gaura.
i, Poisonhemlock.
j, Hedge bindweed.
k, Blueweed.
l, Henbit.
m, Horsenettle.
n, Silverleaf nightshade.
o, Black nightshade.
p, Groundcherry.
q, Jimsonweed.
r, Butter-and-eggs.
s, Dandelion.
t, Common yarrow.

a.—Seeds of tiny vetch (*Vicia hirsuta*) are smaller than those of the cultivated vetches, much compressed, light gray with dark mottling, becoming dull brown with age; scar long linear. A common impurity of cultivated vetch and the clovers.

b.—Seeds of camelthorn (*Alhagi camelorum*) can be distinguished from those of alfalfa by their larger size and olive-green color, usually with purple mottling. The weed is locally established in the

Southwest. The seeds may occur in domestic alfalfa, also in imported seed.

c.—Puncturevine (*Tribulus terrestris*). The burs consist of five united carpels or sections, each bearing two or more very stiff, hard spines. The carpels become hard and separate at maturity. In the illustration the bur is shown natural size, the single carpel five times natural size. Locally common throughout the West, particularly the Southwest.

d.—Seeds of leafy spurge (*Euphorbia esula*) have the appearance of small, grayish-brown beetles. The cylindrical seeds are slightly narrowed at one end, with usually a brownish appendage adhering to the base. Color varies from silvery gray to grayish brown, some seeds mottled darker brown, with a fine, dark-brown line lengthwise along the middle of the seed. Immature seeds often ivory-colored. Found in grass seeds and clover, particularly in the North Central States. This seed is difficult to distinguish from that of cypress spurge (*E. cyparissias*), which is also an objectionable weed.

e.—Alkali mallow (*Sida hederacea*). Seeds are broadly oval, dark brown, with a thin, scurfy coating which gives the seed a grayish appearance. Within the broad notch in the edge is a large, circular scar area with fine lines radiating from the center. The short-beaked seed vessel is triangular in outline. (Compare with spine-mallow, fig. 34, *m.*) Locally common in cultivated fields in the Southwest.

f.—St. Johnswort (*Hypericum perforatum*) seeds are dull dark brown, cylindrical, with a slight projection at one or both ends, the surface mottled with vertical rows of small scars. Found in clovers and grasses from the West and Northwest and in imported seed.

g.—Scarlet gaura (*Gaura coccinea*). The light brown, minutely hairy fruit averages about three-sixteenths of an inch in length. The pedicel-like lower portion has eight longitudinal ridges; the upper portion is expanded into four winglike angles with a small knob or tubercle in each groove between the angles. (See outline of fruit in cross-section view.) Within the hard, nutlike fruit are four seeds. The position of the seeds is shown in the sectional views of the fruit. Occurs in grain and coarse grass seeds.

h.—Wavy-leaved gaura (*Gaura sinuata*). The hard, nutlike fruit averages about six-sixteenths inch in length, light brown or greenish in color, the fine surface hairs not always evident with a hand lens. The lower portion shows four indistinct ridges, the upper portion has four winglike angles, with deep grooves between the angles at the top. The cross-section view shows the outline of the fruit cut at the broadest point. As in scarlet gaura, the fruit contains four seeds, their position being shown in the sectional views. Occurs in grain and coarse grass seeds.

i.—Seeds of poisonhemlock (*Conium maculatum*) are dark brown, flattened on one face, strongly arched on the other, with five wavy light-colored ribs extending lengthwise on the arched side; the surface between the ribs appears finely lined. A widespread plant. Occurs in clover, alfalfa, and grasses.

j.—Seeds of hedge bindweed (*Convolvulus sepium*) average about twice the size of bindweed seeds (fig. 32, *e*), dull dark brown or black, smooth or occasionally slightly roughened, one face convex,

the other angled, with a distinct oval depression on each side. May occur in seeds of cereals and the coarse grasses.

k.—The nutlike seeds of blueweed (*Echium vulgare*) are dull gray or dark brown, the surface roughened by light-colored ridges and tubercles; three-angled, the two inner faces flat, the back rounded; the base is a conspicuous flat area showing two projecting points near the center and a minute cavity at the inner angle. (Compare with field gromwell, fig. 32, *k*.) Found chiefly in clovers in the eastern half of the United States.

l.—The seeds of henbit (*Lamium amplexicaule*) are slender, light-brown nutlets, with minute but distinct white flecks over the entire surface; sharply three-angled; the scar a yellowish wrinkled tissue at the pointed base. Occurs chiefly in the clovers.

m.—Horsenettle (*Solanum carolinense*). Fruit when ripe is an orange-colored berry filled with small flat seeds, somewhat resembling tomato seeds. The seeds are broadly ovate in outline, slightly convex on both sides, the surface smooth or very finely granular; the seed scar in a shallow depression in the edge at the narrower end; color varies from gray to pale yellow or orange yellow. Depending somewhat on the degree of ripeness of the fruit at time of harvest, the seeds may appear dull and weathered, or glossy, as if varnished. The dull, grayish seeds are the type most commonly found in crop seeds. Frequently found in lespedeza and grass seeds.

n.—Seeds of silverleaf nightshade (*Solanum elaeagnifolium*) may be distinguished from those of horsenettle by their brown color and larger size, being about twice the width of the latter. They are more nearly circular in outline, and the edge is notched at the scar. Occurs in cultivated fields, chiefly in the Southwest.

o.—Black nightshade (*Solanum nigrum*) seeds are egg-shaped in general outline, flat, dull light brown or yellowish, surface finely pitted or reticulated. The small size and roughened surface distinguishes it from the seed of horsenettle. Occurs in clover, lespedeza, and the small-seeded grasses.

p.—Groundcherry (*Physalis* spp.). The fruit is a many-seeded berry, yellow, orange red or purple in color. The seeds are broadly oval, flat, light gray or yellowish, the scar in a notch in the edge; surface appears spongelike in texture. The shape together with the characteristic surface texture helps to distinguish it from the smoother seeds of horsenettle and from the more definitely pitted seeds of black nightshade. Commonly found in clover seed.

q.—Jimsonweed (*Datura stramonium*). The fruit is a hard, prickly, many-seeded capsule splitting at maturity into four valves. The seeds are dark brown or reddish brown, kidney-shaped, flat, the scar in the straight or slightly concave edge. The surface of the seed is roughened by fine pits or stipples and numerous shallow depressions. Because of its large size it would be likely to occur only with grain or the large-seeded grasses.

r.—Seeds of butter-and-eggs (*Linaria vulgaris*) are dark brown or black, with a slight metallic luster; circular in outline, flattened, surrounded by a relatively wide wing margin, the wing notched at one side and covered with numerous radiating ridges. The surface of the seed is roughened by numerous projecting points. May occur as an impurity in clover, alfalfa, and grass seed.

s.—Dandelion (*Taraxacum officinale*) seeds are light brown to reddish brown, broadly lance-shaped, flattened or slightly four-angled, coarsely ribbed lengthwise, the ribs on the upper half of the seed bearing coarse barbs or prickles. The upper part of the long beak is usually broken away. A common impurity of the smaller-seeded grasses.

t.—Seeds of common yarrow (*Achillea millefolium*) are about one-twelfth of an inch long, gray or creamy white, thin, wedge-shaped, the apex with rounded corners and broadly notched at the center; surface slightly wrinkled lengthwise. Because of the small size and light weight, the seeds are found chiefly with the very small and chaffy grass seeds.

FIGURE 38.—Weed seeds found in farm seeds. (Enlarged and natural size.)

a, Perennial sowthistle.
b, Common sowthistle.
c, Prickly sowthistle.
d, Yellow star-thistle.
e, Malta star-thistle.
f, Purple star-thistle.
g, Russian knapweed.
h, Iberian star-thistle.
i, Chilean tarweed.
j, Blue lettuce.
k, Texas blueweed.
l, Smooth hawksbeard.
m, Bristly hawksbeard.
n, Australian burnweed.
o, Groundsel.
p, Western ragweed.
q, Great burdock.
r, Silverleaf poverty-weed.
s, Poverty-weed.
t, Galinsoga.
u, Whitetop fleabane.

a.—Seeds of perennial sowthistle (*Sonchus arvensis*) are oblong, dull, dark reddish brown, slightly flattened, coarsely ribbed lengthwise, with fine crosswise wrinkles. The mature seed has a dense tuft of hairs at the apex, but this is usually lacking in seed found in crop-seed samples. Occurs in the clovers and coarse grasses.

b.—Common sowthistle (*Sonchus oleraceus*) seeds are straw-colored or reddish brown, lance-shaped and flattened, but not so thin as prickly sowthistle, the edges not evidently margined. Each face is lightly five-ridged lengthwise, with fine crosswise wrinkles, the most conspicuous character being the two longitudinal grooves as shown by the fine dark lines in the illustration. (Compare with the coarse, prominent ridges in perennial sowthistle.) Commonly found in clover and alfalfa.

c.—Prickly sowthistle (*Sonchus asper*) seeds are straw-colored or reddish brown, broadly oblong or lance-shaped, with a winglike margin evident in the broader seeds; seeds thin and flat, the two faces similar, each bearing three fine but distinct longitudinal lines, surface smooth. Common in grass seeds.

d.—Seeds of yellow star-thistle (*Centaurea solstitialis*) vary from cream white or light brown to dark brown, with small light-colored flecks slightly flattened; the scar in a notch of one edge above the rounded base; the apex truncate or flattened, with a small tubercle or knob in the middle. Some of the seeds retain the brush of light-colored bristles at the apex. Found in western-grown alfalfa and in imported seed.

e.—Seeds of Malta star-thistle (*Centaurea melitensis*) average about the same size as those of yellow star-thistle; silvery gray, with white longitudinal lines; a brush of white bristles at the apex. The seed tapers to a hooklike base within which is the scar. Occurs in western-grown alfalfa, also in Argentina.

f.—Purple star-thistle (*Centaurea calcitrapa*) seeds, being short and plump, are roughly oval in outline; pearl gray variously flecked or streaked with brown, sometimes indistinctly so; the brush of bristles at the apex lacking. Compare with the more slender and darker colored seeds of yellow star-thistle. Occurs in the clovers and alfalfa, chiefly in imported seed, and possibly from the Pacific coast.

g.—Seeds of Russian knapweed (*Centaurea picris*) are somewhat larger than alfalfa seeds; ivory-colored; the shape obovate and somewhat flattened, with indistinct lengthwise lines. The color, together with its larger size, makes its presence readily detected in alfalfa seed. May occur in seed from the Southwest; frequent in alfalfa from Turkistan.

h.—Seeds of Iberian star-thistle (*Centaurea iberica*) are usually light gray, irregularly streaked and mottled with dark brown. At the apex is a brush of silvery bristles of unequal length; the base of the seed is sharply notched. Compare with other star-thistles in figure 38 and cornflower, figure 35, *p.* Locally established on the Pacific coast.

i.—Chilean tarweed (*Madia sativa*) seeds are a dull jet black or gray and black mottled; narrowly ovate, straight or curved and thicker on the convex edge; the two faces are flattened, with a more or less evident central ridge. Many of the seeds show a hooklike notch at the base, others are not evidently notched. The surface is finely lined lengthwise. Occurs in clover and coarse grass seeds in the Western States.

j.—Blue lettuce (*Lactuca pulchella*) seeds are dark reddish brown, oblong elliptical, flattened, with three to five vertical ridges on each side, and tapering into a stout beak. In unrubbed seed a tuft of long, fine white hairs is usually present at the apex. Occurs in grainfields and meadows in the North Central States and westward.

k.—Seeds of Texas blueweed (*Helianthus ciliaris*) are roughly ovate in outline and irregularly angled; surface smooth or faintly lined lengthwise; bronze-colored, with a slight luster. The seeds may be distinguished from those of the common sunflower (fig. 32, *p*) by their smaller size, color, and polished surface. Occurs in the Southwest.

l.—Smooth hawksbeard (*Crepis capillaris*) seeds are light brown, with lighter-colored longitudinal ridges; apex truncate, with a light-colored rim. The mature seed has a tuft of fine hairs at the apex, but these are rarely present on the seeds found in crop-seed samples. May occur in clovers and grasses from the Northwest; also in imported seed.

m.—Seeds of bristly hawksbeard (*Crepis setosa*) may be distinguished from those of smooth hawksbeard by the slender beak which is nearly as long as the seed proper, the apex of the beak expanded into a disk. Very minute bristles may be seen along the light-colored ridges, especially toward the top. As in smooth hawksbeard, the tuft of hairs at the tip of the beak is seldom present, and the long beak may be partially broken away. Found in clover and fine grass seeds from the Northwest; also in imported seed.

n.—Seeds of Australian burnweed (*Erechtites prenanthoides*) are dark brown or light yellowish brown, cylindrical, the apex truncate with a light-colored rim at the margin. Within this rim a tiny, knoblike projection may be seen. Six ribs extend lengthwise of the seed, and along the ribs are short light-colored hairs. The seed appears six-angled in cross section. Found in small grass seed from the Pacific coast. In another species of burnweed (*Erechtites hieracifolia*) the seeds are dark brown with 10 prominent, light-colored ribs, and a few whitish hairs between the ribs. Compare the burnweeds with oxeye daisy (fig. 32, *q*), black-eyed-susan (fig. 35, *l*), and groundsel (below).

o.—Groundsel (*Senecio vulgaris*) seeds are slender, club-shaped, with 10 longitudinal ribs. Between the ribs, as shown in the illustration, are numerous fine, light-colored hairs. Because of the small size, the seed may appear to be hairy over the entire surface when examined at low magnification. Widespread throughout the North and Northwest, it occurs chiefly in small-seeded grasses from the Pacific coast.

p.—Seeds of western ragweed (*Ambrosia psilostachya*) are dull grayish brown in color, sparsely white-hairy on the upper half of the seed. They may be distinguished from seeds of the common ragweed (fig. 32, *n*) by the absence of spines at the apex, having instead blunt knobs or tubercles, usually five in number. The weed is widely distributed throughout the Great Plains States, and the seeds may occur in the same crop seeds as the common ragweed.

q.—Great burdock (*Arctium lappa*) seeds are dull grayish brown mottled with darker brown; rounded on one side and angled on the other, or sometimes flattened on both sides; surface finely wrinkled

lengthwise; at the apex is a characteristic light-colored, circular scar. Widely distributed. Seeds of smaller burdock (*Arctium minus*) are similar to those of great burdock but average a little smaller in size.

r.—Silverleaf poverty-weed (*Franseria discolor*). Fruit is an ovoid bur nearly one-fourth of an inch in length, light grayish tan in color, with minute white hairs scattered over the surface. At the top of the bur are two short, spine-tipped beaks, and projecting from the sides of the bur are stiff spines, usually five in number. These spines are flattened at the point of attachment and taper to needlelike points, which are sometimes slightly bent or hooked. Occurs in the Central Plains States and in the Southwest. The somewhat similar burs of woolly poverty-weed (*F. tomentosa*) may be distinguished by the slightly larger size, the spines not flattened at the base and more numerous, and the absence of fine white hairs on the surface. Compare with the closely related ragweeds and *Iva axillaris*, also called poverty-weed (fig. 35, *k*).

s.—Poverty-weed (*Franseria tenuifolia*). Fruit is a bur, about one-eighth of an inch in length, yellowish straw color, sparsely hairy, with a single hooked spine at the top. The upper half of the bur is deeply pitted, with a hooked spine projecting from the base of each pit. The lower portion is slightly flattened and lightly ridged lengthwise. The plant occurs in the Southwest. The burs of *F. confertiflora*, a species of poverty-weed occurring in the Southeastern States, are very similar.

t.—Seeds of galinsoga (*Galinsoga parviflora*) are scarcely one-eighth of an inch long, wedge-shaped and slightly four-angled, black, with numerous light-colored hairs on the surface. Attached at the margin of the flattened apex is a row of stiff, light-colored, fringed scales, usually 20 in number, which spread out at right angles to the seed at maturity. The weed is widely distributed. Because of its small size the seed may be expected to occur with the small-seeded grasses.

u.—Whitetop fleabane (*Erigeron annuus*) seeds are about one twenty-fourth of an inch in length, linear-oblong in outline, thin and flat, the narrow-margined edges usually lighter in color than the cream or pinkish-brown seed. Very fine appressed hairs are usually present on the surface, and some of the bristles at the apex often persist. Compare with the seeds of common yarrow (fig. 37, *t*), which are larger and notched at the top. The seeds of the fleabanes are very similar and difficult to distinguish. Horseweed or Canada fleabane (*E. canadensis*) and daisy fleabane (*E. ramosus*) are other objectionable species of this group. Seeds of the fleabanes are likely to occur with the small-seeded grasses.

APPENDIX

TABLE 1.—*Weed seeds illustrated in this bulletin and the crop seeds in which they are commonly found*

Weed seeds (shown in figs. 31–38)	Crop seeds																		
	Alfalfa	Alsike clover	Crimson clover	Red clover	Sweetclover (white and yellow)	White clover	Lespedeza	Vetch	Winter rape	Flax	Kentucky bluegrass	Meadow fescue	Millet	Oats	Orchard grass	Redtop	Smooth brome	Sudan grass	Timothy	Wheat
Figure 31 (described on pp. 37 to 39):																				
a, Field sandbur	x			x														x		
b, Wild oat	x			x				x						x	x		x			x
c, Chess	x		x	x			x	x				x		x	x		x		x	x
d, Darnel			x																	x
e, Quackgrass	x			x	x							x		x	x		x			x
f, Curly dock	x	x	x	x	x	x	x				x	x	x	x	x	x	x		x	x
g, Cornbind	x		x	x	x					x			x	x	x		x		x	x
h, Russian-thistle	x			x	x					x			x				x	x		x
i, Corncockle	x		x					x		x			x	x						x
j, Evening campion	x	x	x	x	x	x									x				x	
k, Bladder campion	x	x	x	x	x	x						x			x				x	
l, Nightblooming catchfly	x	x	x	x	x	x	x		x				x	x	x				x	
m, Cowcockle	x				x			x		x			x	x			x			x
n, Pennycress	x	x	x	x	x	x				x			x				x			x
o, Field peppercress	x	x	x	x	x		x					x	x	x	x		x			x

p, Bigseed falseflax	x	x	x	x		x		x		x			x				x						x
q, Littleseed falseflax	x	x	x	x	x	x					x	x			x		x			x			
r, Ballmustard			x					x		x			x										x
s, Black mustard	x		x	x	x			x												x			x
t, Charlock	x	x	x	x	x	x		x	x			x	x	x			x	x					x
Figure 32 (described on pp. 40 to 42):																							
a, India mustard	x		x	x	x			x	x	x		x	x	x									x
b, Hares-ear-mustard	x		x		x					x			x	x	x		x						x
c, Tumblemustard	x	x		x		x				x	x		x	x	x	x	x			x	x		x
d, Wild carrot	x		x	x	x	x	x						x	x						x			
e, Bindweed	x			x			x	x		x			x				x						x
f, Flax dodder										x													
g, Clover dodder	x	x	x	x		x																	
h, Littleseed dodder	x	x			x																		
i, Field dodder	x		x	x			x	x															
j, Bigseed dodder	x																						
k, Field gromwell	x		x	x	x						x		x										x
l, Blackseed plantain	x	x	x	x		x	x				x	x	x	x	x	x				x			
m, Buckhorn plantain	x	x	x	x	x	x	x				x	x	x	x	x	x	x	x	x				
n, Common ragweed	x	x		x	x		x					x	x	x			x	x					x
o, Curlycup gumweed	x				x						x				x		x						
p, Common sunflower	x			x	x		x						x			x	x	x					x
q, Oxeye daisy	x	x	x	x	x	x					x				x	x	x			x			
r, Canada thistle	x	x	x	x	x	x					x		x	x	x					x	x		
s, Bull thistle	x			x			x										x						x
t, Chicory	x		x	x	x								x										

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TABLE 1.—*Weed seeds illustrated in this bulletin and the crop seeds in which they are commonly found*—Continued

Weed seeds (shown in figs. 31–38)	Crop seeds																			
	Alfalfa	Alsike clover	Crimson clover	Red clover	Sweetclover (white and yellow)	White clover	Lespedeza	Vetch	Winter rape	Flax	Kentucky bluegrass	Meadow fescue	Millet	Oats	Orchard grass	Redtop	Smooth brome	Sudan grass	Timothy	Wheat
Figure 33 (described on pp. 43 to 45):																				
a, Crabgrass	x		x	x	x		x				x	x	x	x	x	x		x		
b, Witchgrass	x	x	x	x		x	x					x	x		x	x		x	x	
c, Yellow bristlegrass	x	x	x	x	x		x	x				x	x	x			x	x	x	x
d, Green bristlegrass	x	x	x	x	x	x	x	x				x	x	x			x	x	x	x
e, Velvet grass		x		x	x	x						x			x		x			
f, Soft chess	x		x	x	x		x					x	x		x		x			
g, Sedge		x		x		x	x				x	x			x	x	x		x	
h, Sheep sorrel	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x			x	
i, Knotweed	x	x	x	x	x	x	x						x	x						
j, Pale ladysthumb	x		x	x	x		x			x			x	x				x		x
k, Ladysthumb	x			x	x	x	x					x	x	x			x	x	x	x
l, Lambsquarters	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
m, Wedgescale orach	x														x					
n, Redroot amaranth	x	x		x	x	x	x				x		x	x			x	x	x	
o, Spreading amaranth	x	x		x			x						x							
p, Corn spurry	x	x	x	x		x		x				x	x	x					x	
q, Little starwort	x	x	x	x		x														

r, Chickweed	x	x	x	x	x	x										x						
s, Big mouse-ear chickweed	x	x	x	x		x					x				x	x				x		
t, Clover catchfly	x		x	x	x	x																
Figure 34 (described on pp. 46 to 48):																						
a, Creeping buttercup	x		x	x								x	x		x							
b, American peppercress	x	x	x	x		x					x	x			x	x				x		
c, Shepherds-purse	x	x	x	x	x	x					x	x		x	x	x	x			x		
d, Strawberryweed	x	x		x	x	x					x	x	x	x	x	x	x			x		
e, Mignonette clover	x	x	x	x		x	x							x	x	x						
f, Black medic	x	x	x	x		x						x					x			x		
g, Birdsfoot trefoil	x		x	x	x	x																
h, Cutleaf cranesbill	x		x	x	x	x		x							x							
i, Dovefoot cranesbill	x		x	x	x	x									x							
j, Small cranesbill	x	x	x	x		x									x							
k, Alfilaria			x	x			x															
l, Nodding spurge	x	x	x	x	x		x				x	x		x								
m, Spinemallow	x			x			x						x									
n, Evening-primrose	x	x		x		x	x										x			x		
o, Red pimpernel	x		x	x	x	x							x									
p, European stickseed	x			x	x					x			x				x					x
q, Forget-me-not		x	x	x		x					x	x				x				x		
r, Vervain	x		x	x	x							x	x	x								
s, White vervain			x	x			x				x									x		
t, Blue vervain		x		x		x					x					x				x		

TABLE 1.—*Weed seeds illustrated in this bulletin and the crop seeds in which they are commonly found*—Continued

Weed seeds (shown in figs. 31–38)	Crop seeds																		
	Alfalfa	Alsike clover	Crimson clover	Red clover	Sweetclover (white and yellow)	White clover	Lespedeza	Vetch	Winter rape	Flax	Kentucky bluegrass	Meadow fescue	Millet	Oats	Orchard grass	Redtop	Smooth brome	Sudan grass	Timothy	Wheat
Figure 35 (described on pp. 51 to 49):																				
a, Catnip	x	x		x		x		x											x	
b, Selfheal	x	x	x	x	x	x	x	x					x		x					
c, Roundleaf toadflax	x		x	x																
d, Rippleseed plantain	x	x	x	x	x	x					x		x		x	x			x	
e, Bottlebrush plantain	x	x		x	x	x	x					x	x	x	x	x			x	
f, Paleseed plantain		x	x			x					x				x	x			x	
g, Fieldmadder	x		x	x	x	x						x			x					
h, Catchweed	x		x	x		x		x	x	x	x	x	x	x	x	x	x			x
i, Toothed cornsalad	x		x	x		x														
j, Italian cornsalad	x		x	x																
k, Sumpweed	x			x	x		x													
l, Black-eyed-susan				x												x			x	
m, Mayweed	x	x	x	x	x	x					x	x	x	x	x	x			x	x
n, Field camomile	x	x	x	x	x	x	x						x		x	x		x	x	
o, False-camomile	x	x	x	x	x	x									x					
p, Cornflower	x		x	x	x					x			x		x		x			
q, Spotted cats-ear	x		x	x							x	x			x					

r, Oxtongue	x			x																		
s, Hawkweed picris	x		x	x	x	x																
t, Orange hawkweed												x	x									
Figure 36 (described on pp. 52 to 55):																						
a, Rattail fescue	x	x	x	x		x	x						x			x		x				
b, Downy chess	x			x												x						
c, Bermuda grass	x				x	x	x							x		x		x				
d, Foxtail barley	x			x																		
e, Canada wild-rye																		x				
f, Water foxtail				x		x						x				x						
g, Smooth crabgrass	x			x			x													x		
h, Knotgrass	x			x																		
i, Nutgrass	x						x															
j, Chufa																						
k, Wild garlic			x		x		x	x							x	x			x		x	
l, Silversheath knotweed	x																					
m, Bassia	x			x																		
n, Bitter wintercress	x	x		x	x	x	x					x		x		x				x		
o, Early wintercress	x	x		x		x	x					x			x	x						
p, Perennial peppercress	x					x																
q, Hoarycress	x	x		x	x															x	x	
r, Austrian fieldcress																						
s, Wild radish	x			x																		
t, Wild rose	x			x	x										x			x			x	

TABLE 1.—*Weed seeds illustrated in this bulletin and the crop seeds in which they are commonly found*—Continued

Weed seeds (shown in figs. 31–38)	Crop seeds																		
	Alfalfa	Alsike clover	Crimson clover	Red clover	Sweetclover (white and yellow)	White clover	Lespedeza	Vetch	Winter rape	Flax	Kentucky bluegrass	Meadow fescue	Millet	Oats	Orchard grass	Redtop	Smooth brome	Sudan grass	Timothy	Wheat
Figure 37 (described on pp. 56 to 59):																				
a, Tiny vetch			x	x				x												
b, Camelthorn	x																			
c, Puncturevine	x																			
d, Leafy spurge	x													x			x			
e, Alkali mallow	x																		x	
f, St. Johnswort				x			x									x				
g, Scarlet gaura														x			x			x
h, Wavyleaved gaura														x						x
i, Poisonhemlock																				
j, Hedge bindweed	x						x	x									x			x
k, Blueweed	x			x																
l, Henbit				x	x	x														
m, Horsenettle	x			x			x							x					x	
n, Silverleaf nightshade	x																		x	
o, Black nightshade							x													
p, Groundcherry	x			x																
q, Jimsonweed																				

r, Butter-and-eggs	x	x		x																x		
s, Dandelion				x		x																
t, Common yarrow		x		x		x												x				
Figure 38 (described on pp. 60 to 63):																						
a, Perennial sowthistle	x			x	x							x					x				x	
b, Common sowthistle	x			x																		
c, Prickly sowthistle				x		x																
d, Yellow star-thistle	x			x																		
e, Malta star-thistle	x			x																		
f, Purple star-thistle	x			x																		
g, Russian knapweed	x			x																		x
h, Iberian star-thistle	x			x																		
i, Chilean tarweed	x			x																		
j, Blue lettuce																			x			
k, Texas blueweed																						
l, Smooth hawksbeard	x			x	x	x					x					x						
m, Bristly hawksbeard	x			x								x										
n, Australian burnweed																						
o, Groundsel				x		x																
p, Western ragweed	x																					x
q, Great burdock	x			x																		
r, Silverleaf poverty-weed	x				x														x			
s, Poverty-weed	x				x														x			
t, Galinsoga																		x				
u, Whitetop fleabane				x												x	x					

TABLE 1.—*Weed seeds illustrated in this bulletin and the crop seeds in which they are commonly found*—Continued

Weed seeds (miscellaneous figures)	Crop seeds																				
	Alfalfa	Alsike clover	Crimson clover	Red clover	Sweetclover (white and yellow)	White clover	Lespedeza	Vetch	Winter rape	Flax	Kentucky bluegrass	Meadow fescue	Millet	Oats	Orchard grass	Redtop	Smooth brome	Sudan grass	Timothy	Wheat
Figure 26, *d*, Barnyard grass	x			x	x															
Figure 7, Black medic	x	x	x	x	x	x	x	x						x						
Figure 9, *b*, California bur-clover	x		x	x									x	x				x		x
Figure 29, *B*, Johnson grass	x			x	x		x						x	x				x		
Figure 19, *e*, Narrowleaf vetch	x			x				x					x							
Figure 26, *a*, Proso	x		x	x	x									x						
Figure 17, *c*, Sourclover	x	x		x	x	x														
Figure 9, *c*, Spotted bur-clover	x		x	x																
Figure 19, *f*, Purple vetch			x	x				x												

TABLE 2.—*List of weed seeds and crop seeds illustrated or described in this bulletin*

English or common name	Other locally recognized English or common names	Latin name	Figure	Page
Alfalfa	Lucerne	*Medicago sativa* L.	4	16
Alfilaria	Storksbill, filaree	*Erodium cicutarium* (L.) L'Her.	34, *k*	47
Amaranth:				
Redroot	Rough pigweed, carelessweed	*Amaranthus retroflexus* L.	33, *n*	45
Spreading	Spreading pigweed	*Amaranthus blitoides* Wats.	33, *o*	45
Tumble	Tumbling pigweed	*Amaranthus graecizans* L.		45
Ballcress	Whitetop, globe-podded hoary-cress, Siberian mustard.	*Hymenophysa pubescens* C. A. Mey.		55
Ballmustard		*Neslia paniculata* (L.) Desv.	31, *r*	39
Barley		*Hordeum vulgare* L.		31
Barley, foxtail	Wild barley, squirreltail barley	*Hordeum jubatum* L.	36, *d*	53
Barnyard grass	Water grass	*Echinochloa crusgalli* (L.) Beauv.	26, *d*	30
Bassia	Fivehook bassia	*Bassia hyssopifolia* (Pall.) Ktze.	36, *m*	54
Belvedere	Summer cypress	*Kochia scoparia* (L.) Schrad.		54
Bermuda grass	Devil grass, wire-grass	*Cynodon dactylon* (L.) Pers.	36, *c*	53
Bindweed	Wild morning-glory, tie vine, European morning-glory, creeping jennie, small-flowered morning-glory, lesser bindweed.	*Convolvulus arvensis* L.	32, *e*	41
Bindweed, hedge	Great bindweed, wild morning-glory, bracted bindweed.	*Convolvulus sepium* L.	37, *j*	57
Black-eyed-susan	Yellow daisy	*Rudbeckia hirta* L.	35, *l*	50
Black medic	Yellow trefoil	*Medicago lupulina* L.	7 34, *f*	17 47

TABLE 2.—*List of weed seeds and crop seeds illustrated or described in this bulletin*—Continued

English or common name	Other locally recognized English or common names	Latin name	Figure	Page
Bluegrass:				
Canada		*Poa compressa* L.	23, *b*	27
Kentucky	Bluegrass	*Poa pratensis* L.	21 23, *a*	27
Bluestem	Western wheatgrass	*Agropyron smithii* Rydb.		38
Blueweed	Blue-thistle	*Echium vulgare* L.	37, *k*	58
Blueweed, Texas		*Helianthus ciliaris* DC.	38, *k*	62
Bristlegrass:				
Green	Pigeon grass, wild millet, green foxtail.	*Setaria viridis* (L.) Beauv.	33, *d*	44
Yellow	Yellow foxtail, pigeon grass	*Setaria lutescens* (Weigel) F. T. Hubb.	33, *c*	44
Brome, smooth	Awnless bromegrass, Hungarian brome.	*Bromus inermis* Leyss.	25, *a*	33
Bur-clover:				
California	Toothed bur-clover	*Medicago hispida* Gaertn.	9, *b*	17
Spotted	Southern bur-clover	*Medicago arabica* Huds.	9, *c*	17
Burdock:				
Great	Big burdock	*Arctium lappa* L.	38, *q*	62
Smaller	Clotbur	*Arctium minus* Bernh.		63
Burnweed	Fireweed	*Erechtites hieracifolia* (L.) Raf.		62
Burnweed, Australian	do	*Erechtites prenanthoides* (Rich.) DC.	38, *n*	62
Butter-and-eggs	Yellow toadflax	*Linaria vulgaris* Hill	37, *r*	58
Buttercup, creeping		*Ranunculus repens* L.	34, *a*	46
Camelthorn		*Alhagi camelorum* Fisch.	37, *b*	56
Camomile, field	Corn camomile	*Anthemis arvensis* L.	35, *n*	50

Campion:				
Bladder		*Silene cucubalus* Wibel	31, *k*	39
Evening	White campion, white cockle	*Lychnis alba* Mill	31, *j*	38
Carrot, wild		*Daucus carota* L	32, *d*	41
Catchfly:				
Clover	Forked catchfly, hairy catchfly	*Silene dichotoma* Ehrh	33, *t*	45
Nightblooming	Night-flowering catchfly, sticky cockle.	*Silene noctiflora* L	31, *l*	39
Catchweed	Cleavers, bedstraw, goosegrass	*Galium aparine* L	35, *h*	50
Catnip	Catmint	*Nepeta cataria* L	35, *a*	49
Cats-ear, spotted	Cats-ear, coast dandelion	*Hypochaeris radicata* L	35, *q*	51
Charlock	Wild mustard	*Brassica kaber* (DC.) Wheeler	31, *t*	39
Chess	Cheat	*Bromus secalinus* L	25, *d* 31, *c*	38
Chess:				
Downy	Downy bromegrass, slender chess	*Bromus tectorum* L	36, *b*	53
Soft	Soft brome	*Bromus mollis* L	33, *f*	44
Chickweed		*Stellaria media* (L.) Cyrill	33, *r*	45
Chickweed, big mouse-ear.	Mouse-ear chickweed	*Cerastium vulgatum* L	33, *s*	45
Chicory		*Cichorium intybus* L	32, *t*	42
Chufa	Yellow nutgrass, earth almond, nut-sedge.	*Cyperus esculentus* L	36, *j*	54
Cinquefoil. (*See* Strawberryweed.)				
Clover:				
Alsike		*Trifolium hybridum* L	10	18
Crimson		*Trifolium incarnatum* L	12	19
Mignonette	Low hop clover	*Trifolium procumbens* L	34, *e*	47
Red		*Trifolium pratense* L	13	19
Suckling	Hop clover	*Trifolium dubium* Sibth		47
White		*Trifolium repens* L	11, *b*	19

TABLE 2.—*List of weed seeds and crop seeds illustrated or described in this bulletin*—Continued

English or common name	Other locally recognized English or common names	Latin name	Figure	Page
Corn		*Zea mays* L		26
Cornbind	Black bindweed, wild buckwheat	*Polygonum convolvulus* L	31, *g*	38
Corncockle	Blue cockle, cockle	*Agrostemma githago* L	31, *i*	38
Cornflower	Blue bottle, bachelor's-button, French pink.	*Centaurea cyanus* L	35, *p*	51
Cornsalad:				
Italian		*Valerianella eriocarpa* Desv	35, *j*	50
Toothed		*Valerianella dentata* Pollich	35, *i*	50
Cowcockle	Cockle, cowherb, pink cockle	*Saponaria vaccaria* L	31, *m*	39
Crabgrass	Fingergrass, crowfoot grass	*Digitaria sanguinalis* (L.) Scop	33, *a*	43
Crabgrass, smooth	Small crabgrass, fingergrass	*Digitaria ischaemum* (Schreb.) Muhl	36, *g*	53
Cranesbill:				
Cutleaf		*Geranium dissectum* L	34, *h*	47
Dovefoot	Pigeon-foot	*Geranium molle* L	34, *i*	47
Small	Small-flowered cranesbill	*Geranium pusillum* Burm. f	34, *j*	47
Dandelion		*Taraxacum officinale* Weber	37, *s*	59
Daisy, oxeye	White daisy, field daisy	*Chrysanthemum leucanthemum* L	32, *q*	42
Darnel	Bearded darnel, poison ryegrass	*Lolium temulentum* L	31, *d*	38
Dock:				
Curly	Sour dock, yellow dock	*Rumex crispus* L	31, *f*	38
Bitter	Broad-leaved dock	*Rumex obtusifolius* L		38
Dodder:				
Bigseed	Large-seeded alfalfa dodder	*Cuscuta indecora* Choisy	32, *j*	41
Clover		*Cuscuta epithymum* Murr	6, *b* 15, *b* 32, *g*	41

Field	Large-seeded dodder, lovevine	*Cuscuta pentagona* Engelm	16, *b* 32, *i*	41
Flax	Hairweed	*Cuscuta epilinum* Weihe	22, *b* 22, *c* 32, *f*	27 27 41
Littleseed	Small-seeded alfalfa dodder	*Cuscuta planiflora* Tenore	32, *h*	41
Evening-primrose	Wild beet	*Oenothera biennis* L	34, *n*	48
False-camomile	Scentless false-camomile	*Matricaria inodora* L	35, *o*	51
Falseflax:				
Bigseed	Wildflax, balloon mustard	*Camelina sativa* (L.) Crantz	31, *p*	39
Littleseed	Small fruited falseflax	*Camelina microcarpa* Andrz	31, *q*	39
Fescue:				
Meadow		*Festuca elatior* L	24, *b* 25, *b*	28
Rattail	Doghair	*Festuca myuros* L	36, *a*	52
Fieldcress, Austrian		*Rorippa austriaca* (Crantz) Besser	36, *r*	55
Fireweed. (*See* Burnweed.)				
Flax		*Linum usitatissimum* L	22, *a*	27
Fleabane	Horseweed, Canada fleabane	*Erigeron canadensis* L		63
Fleabane:				
Daisy	Whitetop	*Erigeron ramosus* (Walt.) B. S. P		63
Whitetop	Whitetop, daisy fleabane	*Erigeron annuus* (L.) Pers	38, *u*	63
Forget-me-not		*Myosotis arvensis* (L.) Hill	34, *q*	48
Foxtail. (*See* Bristlegrass.)				
Foxtail, water	Foxtail	*Alopecurus geniculatus* L	36, *f*	53
Galinsoga		*Galinsoga parviflora* Cav	38, *t*	63
Garlic, wild	Wild onion	*Allium vineale* L	36, *k*	54
Gaura:				
Scarlet		*Gaura coccinea* Nutt	37, *g*	57
Wavyleaved		*Gaura sinuata* Nutt	37, *h*	57

TABLE 2.—*List of weed seeds and crop seeds illustrated or described in this bulletin*—Continued

English or common name	Other locally recognized English or common names	Latin name	Figure	Page
Gromwell, field	Corn gromwell, stoneseed	*Lithospermum arvense* L	32, *k*	42
Groundcherry		*Physalis* spp	37, *p*	58
Groundsel	Ragwort	*Senecio vulgaris* (L.)	38, *o*	62
Gumweed, curlycup	Gumweed, tarweed	*Grindelia squarrosa* (Pursh) Dunal	32, *o*	42
Hares-ear-mustard	Treacle mustard	*Conringia orientalis* (L.) Dumort	32, *b*	41
Hawksbeard:				
Bristly		*Crepis setosa* Hall. f	38, *m*	62
Smooth		*Crepis capillaris* (L.) Wallr	38, *l*	62
Hawkweed, orange	Orange paintbrush, devils paintbrush.	*Hieracium aurantiacum* L	35, *t*	51
Henbit	Deadnettle	*Lamium amplexicaule* L	37, *l*	58
Hoarycress	Perennial peppergrass, whitetop	*Lepidium draba* L	36, *q*	55
Horsenettle	Bullnettle, sandbrier	*Solanum carolinense* L	37, *m*	58
Jimsonweed	Thorn-apple	*Datura stramonium* L	37, *q*	58
Johnson grass		*Sorghum halepense* (L.) Pers	29, *B*	33
Knapweed, Russian	Turkistan-thistle	*Centaurea picris* Pall	38, *g*	61
Knotgrass	Wire-grass	*Paspalum distichum* L	36, *h*	53
Knotweed	Door-weed, knotgrass	*Polygonum aviculare* L	33, *i*	44
Knotweed, silversheath		*Polygonum argyrocoleon* Kunze	36, *l*	54
Ladysthumb	Spotted smartweed, smartweed	*Polygonum persicaria* L	33, *k*	44
Ladysthumb, pale	Pale smartweed, willow-weed, pale knotweed.	*Polygonum lapathifolium* L	33, *j*	44
Lambsquarters	Goosefoot, pigweed	*Chenopodium album* L	33, *l*	45
Lettuce, blue	Chicory lettuce	*Lactuca pulchella* (Pursh) DC	38, *j*	62
Lespedeza:				
Common		*Lespedeza striata* (Thunb.) H. and A	18, *A*	22

Kobe		*Lespedeza striata* var	18, *B*	22
Korean		*Lespedeza stipulacea* Maxim	18, *C*	22
Sericea	Chinese lespedeza	*Lespedeza cuneata* G. Don	18, *D*	23
Madder, field	Blue fieldmadder	*Sherardia arvensis* L	35, *g*	50
Mallow, alkali	White mallow, creeping mallow	*Sida hederacea* (Dougl.) Torr	37, *e*	57
Mayweed	Dogfennel, fetid camomile	*Athemis cotula* L	35, *m*	50
Melilot, yellow. (*See* Sourclover.)				
Morning-glory. (*See* Bindweed.)				
Millet:				
Foxtail	Millet	*Setaria italica* (L.) Beauv	26, *b*	30
Japanese	Billion-dollar grass	*Echinochloa crusgalli frumentacea* (Roxb.) W. F. Wight.	26, *c*	30
Mustard:				
Black	Wild mustard, Trieste mustard	*Brassica nigra* (L.) Koch	31, *s*	39
India	Wild mustard, brown mustard, Indian mustard.	*Brassica juncea* (L.) Cosson	32, *a*	40
White	Yellow mustard, white London mustard.	*Brassica hirta* Moench		25
Wild. (*See* Charlock.)				
Nightshade:				
Black		*Solanum nigrum* L	37, *o*	58
Silverleaf	Trompillo, white horsenettle, bull nettle.	*Solanum elaeagnifolium* Cav	37, *n*	58
Nutgrass	Coca-grass, coco-sedge, nut-sedge	*Cyperus rotundus* L	36, *i*	53
Nutgrass. (*See* Chufa.)				
Oat		*Avena sativa* L		31
Oat, wild		*Avena fatua* L	31, *b*	38
Orach, wedgescale	Saltbush	*Atriplex truncata* (Torr.) Gray	33, *m*	45
Orchard grass	Cocksfoot grass	*Dactylis glomerata* L	24, *a*	31
Oxtongue	Bristly oxtongue	*Picris echioides* L	35, *r*	51

TABLE 2.—*List of weed seeds and crop seeds illustrated or described in this bulletin*—Continued

English or common name	Other locally recognized English or common names	Latin name	Figure	Page
Pennycress	Scaleweed, stinkweed, Frenchweed, fan weed.	*Thlaspi arvense* L.	31, *n*	39
Peppercress:				
American	Virginia peppergrass	*Lepidium virginicum* L.	34, *b*	47
Field	Field peppergrass	*Lepidium campestre* (L.) R. Br.	31, *o*	39
Lens-podded	Lens-podded hoarycress, hoary-cress.	*Lepidium draba* var. *repens* (Schrenk) O. E. Schulz.		55
Perennial	Perennial mustard, whitetop	*Lepidium latifolium* L.	36, *p*	55
Picris, hawkweed	Oxtongue, bugloss	*Picris hieracioides* L.	35, *s*	51
Pimpernel, red	Scarlet pimpernel	*Anagallis arvensis* L.	34, *o*	48
Plantain:				
Blackseed	Common plantain, rattail plantain	*Plantago rugelii* Decne.	32, *l*	42
Bottlebrush	Bracted plantain	*Plantago aristata* Michx.	35, *e*	50
Buckhorn	Narrowleaved plantain, ribgrass, ribwort, English plantain.	*Plantago lanceolata* L.	32, *m*	42
Paleseed	Dwarf plantain	*Plantago virginica* L.	35, *f*	50
Rippleseed	Common plantain, broadleaved plantain.	*Plantago major* L.	35, *d*	50
Poisonhemlock	Poison parsley	*Conium maculatum* L.	37, *i*	57
Poverty-weed. (*See* Sumpweed.)				
Poverty-weed		*Franseria tenuifolia* Torr. and Gray	38, *s*	63
Poverty-weed		*Franseria confertiflora* (DC.) Rydb.		63
Poverty-weed, silverleaf	Bur-ragweed, skeletonleaf bur-sage	*Franseria discolor* Nutt.	38, *r*	63
Poverty-weed, woolly		*Franseria tomentosa* Gray		63
Proso	Broomcorn millet, hog millet	*Panicum miliaceum* L.	26, *a*	30

Puncturevine	Calthrop, bur-nut	*Tribulus terrestris* L	37, *c*	57
Quackgrass	Witchgrass, couch grass	*Agropyron repens* (L.) Beauv	31, *e*	38
Radish, wild		*Raphanus raphanistrum* L	36, *s*	55
Ragweed:				
Common	Ragweed	*Ambrosia artemisiifolia* L	32, *n*	42
Western	Perennial ragweed	*Ambrosia psilostachya* DC	38, *p*	62
Rape, winter	Rape	*Brassica napus* L	20	25
Redtop	Herds grass	*Agrostis alba* L	27, 28	32
Rose, wild		*Rosa* spp	36, *t*	55
Russian-thistle	Russian tumbleweed	*Salsola kali* var. *tenuifolia* Tausch	31, *h*	38
Ryegrass, perennial	English ryegrass	*Lolium perenne* L	24, *c* 25, *c*	31 31
Sandbur, field	Sandbur, bur-grass	*Cenchrus pauciflorus* Benth	31, *a*	37
Sedge		*Carex* spp	33, *g*	44
Selfheal	Heal-all	*Prunella vulgaris* L	35, *b*	50
Sheep sorrel	Field sorrel, red sorrel	*Rumex acetosella* L	33, *h*	44
Shepherds-purse		*Capsella bursa-pastoris* (L.) Medic	34, *c*	47
Sourclover	Yellow melilot	*Melilotus indica* (L.) All	17, *c*	21
Sowthistle:				
Common		*Sonchus oleraceus* L	38, *b*	61
Perennial	Creeping sowthistle	*Sonchus arvensis* L	38, *a*	60
Prickly	Spiny sowthistle	*Sonchus asper* (L.) Hill	38, *c*	61
Spinemallow	Prickly sida, spiny sida	*Sida spinosa* L	34, *m*	47
Spurge:				
Cypress	Graveyard spurge	*Euphorbia cyparissias* L		57
Leafy		*Euphorbia esula* L	37, *d*	57
Nodding	Spurge	*Euphorbia preslii* Guss	34, *l*	47
Spurry, corn	Spurry	*Spergula arvensis* L	33, *p*	45
Star-thistle:				
Iberian	Star-thistle	*Centaurea iberica* Trev	38, *h*	61
Malta	Napa-thistle, tocalote	*Centaurea melitensis* L	38, *e*	61
Purple	Caltrops, star-thistle	*Centaurea calcitrapa* L	38, *f*	61

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TABLE 2.—*List of weed seeds and crop seeds illustrated or described in this bulletin*—Continued

English or common name	Other locally recognized English or common names	Latin name	Figure	Page
Star-thistle—Cont'd.				
Yellow	Barnabys knapweed-thistle	*Centaurea solstitialis* L.	38, *d*	61
Starwort, little	Chickweed	*Stellaria graminea* L.	33, *q*	45
Stickseed, European	Sticktight, blue-bur	*Lappula echinata* Gilib.	34, *p*	48
St. Johnswort	Tipton-weed, Klamath-weed, goatweed.	*Hypericum perforatum* L.	37, *f*	57
Strawberryweed	Rough cinquefoil, five-finger	*Potentilla monspeliensis* L.	34, *d*	47
Sudan grass		*Sorghum vulgare* var. *sudanense* (Piper) Hitchc.	29, *A*	33
Sumpweed	Poverty-weed, death weed	*Iva axillaris* Pursh	35, *k*	50
Sunflower, common	Wild sunflower	*Helianthus annuus* L.	32, *p*	42
Sweetclover:				
White		*Melilotus alba* Desr.	17, *a*	20
Yellow		*Melilotus officinalis* (L.) Lam.	17, *b*	20
Tarweed, Chilean	Tarweed	*Madia sativa* Molina	38, *i*	61
Thistle:				
Bull		*Cirsium lanceolatum* (L.) Hill	32, *s*	42
Canada		*Cirsium arvense* (L.) Scop.	32, *r*	42
Timothy		*Phleum pratense* L.	30	34
Toadflax:				
Roundleaf		*Linaria spuria* (L.) Mill.	35, *c*	50
Yellow. (*See* Butter-and-eggs.)				
Trefoil, birdsfoot		*Lotus corniculatus* L.	34, *g*	47
Trefoil, yellow. (*See* Black medic.)				

Tumblemustard	Jim Hill mustard, tall hedge mustard.	*Sisymbrium altissimum* L.	32, *c*	41
Turnip-rape		*Brassica rapa* L. var.		25
Velvet grass		*Holcus lanatus* L.	33, *e*	44
Vervain	European vervain	*Verbena officinalis* L.	34, *r*	48
Vervain:				
Blue		*Verbena hastata* L.	34, *t*	48
White	Nettle-leaved vervain	*Verbena urticifolia* L.	34, *s*	48
Vetch:				
Common	Spring vetch	*Vicia sativa* L.	19, *b*	24
Hairy	Winter vetch	*Vicia villosa* Roth	19, *a*	23
Hungarian		*Vicia pannonica* Crantz	19, *d*	24
Narrowleaf		*Vicia angustifolia* (L.) Reichard	19, *e*	24
Purple		*Vicia atropurpurea* Desf.	19, *f*	24
Tiny		*Vicia hirsuta* (L.) S. F. Gray	37, *a*	56
Woollypod		*Vicia dasycarpa* Tenore	19, *c*	24
Wheat		*Triticum aestivum* L.		34
Wheatgrass, slender		*Agropyron trachycaulum* (Link) Malte (*A. tenerum*).		38
Wheatgrass, western. (*See* Bluestem.)				
Wild-rye:				
Canada	Nodding wild-rye, wild-rye	*Elymus canadensis* L.	36, *e*	53
Virginia		*Elymus virginicus* L.		53
Wintercress:				
Bitter	Wintercress, yellow rocket	*Barbarea vulgaris* R. Br.	36, *n*	54
Early	Scurvygrass	*Barbarea verna* (Mill.) Asch.	36, *o*	54
Wire-grass. (*See* Knotgrass.)				
Witchgrass	Old witchgrass, tumblegrass, ticklegrass.	*Panicum capillare* L.	33, *b*	44
Yarrow, common		*Achillea millefolium* L.	37, *t*	59

TABLE 3.—*Index to Latin names of weed seeds and crop seeds illustrated or described*

Latin name	Figure	Page
Achillea millefolium L.	37, *t*	59
Agropyron repens (L.) Beauv.	31, *e*	38
Agropyron smithii Rydb.		38
Agropyron trachycaulum (Link) Malte (*A. tenerum*)		38
Agrostis alba L.	27	32
	28	32
Agrostemma githago L.	31, *i*	38
Alhagi camelorum Fisch.	37, *b*	56
Alhagi pseudalhagi. (See *A. camelorum.*)		
Allium vineale L.	36, *k*	54
Alopecurus geniculatus L.	36, *f*	53
Alsine graminea. (See *Stellaria graminea.*)		
Alsine media. (See *Stellaria media.*)		
Amaranthus blitoides Wats.	33, *o*	45
Amaranthus graecizans L.		45
Amaranthus retroflexus L.	33, *n*	45
Ambrosia artemisiifolia L.	32, *n*	42
Ambrosia psilostachya DC.	38, *p*	62
Anagallis arvensis L.	34, *o*	48
Anthemis arvensis L.	35, *n*	50
Anthemis cotula L.	35, *m*	50
Arctium lappa L.	38, *q*	62
Arctium minus Bernh.		63
Atriplex truncata (Torr.) Gray	33, *m*	45
Avena fatua L.	31, *b*	38
Avena sativa L.		31
Barbarea vulgaris R. Br.	36, *n*	54
Barbarea verna (Mill.) Asch.	36, *o*	54
Bassia hyssopifolia (Pall.) Ktze.	36, *m*	54
Brassica alba. (See *B. hirta.*)		
Brassica arvensis. (See *B. kaber.*)		
Brassica hirta Moench		25
Brassica kaber (DC.) Wheeler	31, *t*	39
Brassica napus L.	20	25
Brassica juncea (L.) Cosson	32, *a*	40
Brassica rapa L. var.		25
Brassica nigra (L.) Koch	31, *s*	39
Bromus inermis Leyss.	25, *a*	33
Bromus mollis L.	33, *f*	44
Bromus secalinus L.	31, *c*	38
	25, *d*	
Bromus tectorum L.	36, *b*	53
Camelina microcarpa Andrz.	31, *q*	39
Camelina sativa (L.) Crantz	31, *p*	39
Capsella bursa-pastoris (L.) Medic.	34, *c*	47
Carex spp.	33, *g*	44
Cenchrus pauciflorus Benth.	31, *a*	37
Centaurea calcitrapa L.	38, *f*	61
Centaurea cyanus L.	35, *p*	51

TABLE 3.—*Index to Latin names of weed seeds and crop seeds illustrated or described*—Continued

Latin name	Figure	Page
Centaurea iberica Trev	38, *h*	61
Centaurea melitensis L	38, *e*	61
Centaurea picris Pall	38, *g*	61
Centaurea solstitialis L	38, *d*	61
Cerastium vulgatum L	33, *s*	45
Chenopodium album L	33, *l*	45
Chrysanthemum leucanthemum L	32, *q*	42
Cichorium intybus L	32, *t*	42
Cirsium arvense (L.) Scop	32, *r*	42
Cirsium lanceolatum (L.) Hill	32, *s*	42
Conium maculatum L	37, *i*	57
Conringia orientalis (L.) Dumort	32, *b*	41
Convolvulus arvensis L	32, *e*	41
Convolvulus sepium L	37, *j*	57
Crepis capillaris (L.) Wallr	38, *l*	62
Crepis setosa Hall. f	38, *m*	62
Cuscuta arvensis. (See *C. pentagona.*)		
Cuscuta epilinum Weihe	22, *b* 22, *c* 32, *f*	27 27 41
Cuscuta epithymum Murr	6, *b* 32, *g* 15, *b*	 41
Cuscuta indecora Choisy	32, *j*	41
Cuscuta pentagona Engelm	32, *i* 16, *b*	41
Cuscuta planiflora Tenore	32, *h*	41
Cynodon dactylon (L.) Pers	36, *c*	53
Cyperus esculentus L	36, *j*	54
Cyperus rotundus L	36, *i*	53
Dactylis glomerata L	24, *a*	31
Datura stramonium L	37, *q*	58
Daucus carota L	32, *d*	41
Digitaria ischaemum (Schreb.) Muhl	36, *g*	53
Digitaria sanguinalis (L.) Scop	33, *a*	43
Echinochloa crusgalli (L.) Beauv	26, *d*	30
Echinochloa crusgalli frumentacea (Roxb.) W. F. Wight	26, *c*	30
Echium vulgare L	37, *k*	58
Elymus canadensis L	36, *e*	53
Elymus virginicus L		53
Erechtites hieracifolia (L.) Raf		62
Erechtites prenanthoides (Rich.) DC	38, *n*	62
Erigeron annuus (L.) Pers	38, *u*	63
Erigeron canadensis L		63
Erigeron ramosus (Walt.) B. S. P		63
Erodium cicutarium (L.) L'Her	34, *k*	47
Euphorbia cyparissias L		57

TABLE 3.—*Index to Latin names of weed seeds and crop seeds illustrated or described*—Continued

Latin name	Figure	Page
Euphorbia esula L.	37, *d*	57
Euphorbia preslii Guss.	34, *l*	47
Festuca elatior L.	24, *b* 25, *b*	28
Festuca myuros L.	36, *a*	52
Franseria confertiflora (DC.) Rydb.		63
Franseria discolor Nutt.	38, *r*	63
Franseria tenuifolia Torr. and Gray	38, *s*	63
Franseria tomentosa Gray		63
Galinsoga parviflora Cav.	38, *t*	63
Galium aparine L.	35, *h*	50
Gaura coccinea Nutt.	37, *g*	57
Gaura sinuata Nutt.	37, *h*	57
Geranium dissectum L.	34, *h*	47
Geranium molle L.	34, *i*	47
Geranium pusillum Burm. f.	34, *j*	47
Grindelia squarrosa (Pursh) Dun.	32, *o*	42
Helianthus ciliaris DC.	38, *k*	62
Helianthus annuus L.	32, *p*	42
Hieracium aurantiacum L.	35, *t*	51
Holcus lanatus L.	33, *e*	44
Hordeum jubatum L.	36, *d*	53
Hordeum vulgare L.		31
Hymenophysa pubescens C. A. Mey.		55
Hypericum perforatum L.	37, *f*	57
Hypochaeris radicata L.	35, *q*	51
Iva axillaris Pursh	35, *k*	50
Kochia scoparia (L.) Schrad.		54
Lactuca pulchella (Pursh) DC.	38, *j*	62
Lamium amplexicaule L.	37, *l*	58
Lappula echinata Gilib.	34, *p*	48
Lepidium campestre (L.) R. Br.	31, *o*	39
Lepidium draba L.	36, *q*	55
Lepidium latifolium L.	36, *p*	55
Lepidium repens. (See *L. draba.*)		
Lepidium virginicum L.	34, *b*	47
Lespedeza cuneata G. Don	18, *D*	23
Lespedeza sericea. (See *L. cuneata.*)		
Lespedeza stipulacea Maxim.	18, *C*	22
Lespedeza striata (Thunb.) H. and A.	18, *A* 18, *B*	22 22
Linaria spuria (L.) Mill.	35, *c*	50
Linaria vulgaris Hill	37, *r*	58
Linum usitatissimum L.	22, *a*	27
Lithospermum arvense L.	32, *k*	42
Lolium perenne L.	24, *c* 25, *c*	31 31
Lolium temulentum L.	31, *d*	38

TABLE 3.—*Index to Latin names of weed seeds and crop seeds illustrated or described*—Continued

Latin name	Figure	Page
Lotus corniculatus L.	34, *g*	47
Lychnis alba Mill.	31, *j*	38
Madia sativa Molina	38, *i*	61
Matricaria inodora L.	35, *o*	51
Medicago arabica Huds.	9, *c*	18
Medicago hispida Gaertn.	9, *b*	18
Medicago lupulina L.	34, *f*	47
	7	17
Medicago sativa L.	4	16
Melilotus alba Desr.	17, *a*	20
Melilotus indica (L.) All.	17, *c*	21
Melilotus officinalis (L.) Lam.	17, *b*	20
Myosotis arvensis (L.) Hill	34, *q*	48
Nepeta cataria L.	35, *a*	49
Neslia paniculata (L.) Desv.	31, *r*	39
Oenothera biennis L.	34, *n*	48
Panicum capillare L.	33, *b*	44
Panicum miliaceum L.	26, *a*	30
Paspalum distichum L.	36, *h*	53
Phleum pratense L.	30	34
Physalis spp.	37, *p*	58
Picris echioides L.	35, *r*	51
Picris hieracioides L.	35, *s*	51
Plantago aristata Michx.	35, *e*	50
Plantago lanceolata L.	32, *m*	42
Plantago major L.	35, *d*	50
Plantago rugelii Decne.	32, *l*	42
Plantago virginica L.	35, *f*	50
Poa compressa L.	23, *b*	27
Poa pratensis L.	21	
	23, *a*	27
Polygonum argyrocoleon Kunze	36, *l*	54
Polygonum aviculare L.	33, *i*	44
Polygonum convolvulus L.	31, *g*	38
Polygonum lapathifolium L.	33, *j*	44
Polygonum persicaria L.	33, *k*	44
Potentilla monspeliensis L.	34, *d*	47
Prunella vulgaris L.	35, *b*	50
Ranunculus repens L.	34, *a*	46
Raphanus raphanistrum L.	36, *s*	55
Rorippa austriaca (Crantz) Besser	36, *r*	55
Rosa spp.	36, *t*	55
Rudbeckia hirta L.	35, *l*	50
Rumex acetosella L.	33, *h*	44
Rumex crispus L.	31, *f*	38
Rumex obtusifolius L.		38
Salsola kali var. *tenuifolia* Tausch	31, *h*	38
Salsola pestifer. (See *S. kali* var. *tenuifolia.*)		

TABLE 3.—*Index to Latin names of weed seeds and crop seeds illustrated or described*—Continued

Latin name	Figure	Page
Saponaria vaccaria L.	31, *m*	39
Senecio vulgaris L.	38, *o*	62
Setaria italica (L.) Beauv.	26, *b*	30
Setaria lutescens (Weigel) F. T. Hubb.	33, *c*	44
Setaria viridis (L.) Beauv.	33, *d*	44
Sherardia arvensis L.	35, *g*	50
Sida hederacea (Dougl.) Torr.	37, *e*	57
Sida spinosa L.	34, *m*	47
Silene cucubalus Wibel	31, *k*	39
Silene dichotoma Ehrh.	33, *t*	45
Silene latifolia. (See *S. cucubalus.*)		
Silene noctiflora L.	31, *l*	39
Sisymbrium altissimum L.	32, *c*	41
Solanum carolinense L.	37, *m*	58
Solanum elaeagnifolium Cav.	37, *n*	58
Solanum nigrum L.	37, *o*	58
Sonchus arvensis L.	38, *a*	60
Sonchus asper (L.) Hill	38, *c*	61
Sonchus oleraceus L.	38, *b*	61
Sorghum halepense (L.) Pers.	29, *B*	33
Sorghum vulgare var. *sudanense* (Piper) Hitchc.	29, *A*	33
Spergula arvensis L.	33, *p*	45
Stellaria media (L.) Cyrill.	33, *r*	45
Stellaria graminea L.	33, *q*	45
Taraxacum officinale Weber	37, *s*	59
Thlaspi arvense L.	31, *n*	39
Tribulus terrestris L.	37, *c*	57
Trifolium dubium Sibth.		47
Trifolium hybridum L.	10	18
Trifolium incarnatum L.	12	19
Trifolium pratense L.	13	19
Trifolium procumbens L.	34, *e*	47
Trifolium repens L.	11, *b*	19
Triticum aestivum L.		34
Vaccaria pyramidata. (See *Saponaria vaccaria.*)		
Valerianella dentata Pollich	35, *i*	50
Valerianella eriocarpa Desv.	35, *j*	50
Verbena hastata L.	34, *t*	48
Verbena officinalis L.	34, *r*	48
Verbena urticifolia L.	34, *s*	48
Vicia angustifolia (L.) Reichard	19, *e*	24
Vicia atropurpurea Desf.	19, *f*	24
Vicia dasycarpa Tenore	19, *c*	24
Vicia hirsuta (L.) S. F. Gray	37, *a*	56
Vicia pannonica Crantz	19, *d*	24
Vicia sativa L.	19, *b*	24
Vicia villosa Roth	19, *a*	23
Zea mays L.		26

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